Operating Instructions

TDR sensor for continuous level and interface measurement of liquids

VEGAFLEX 86

4 … 20 mA/HART two-wire

Rod and cable probe

With SIL qualification

Document ID: 44234

Contents

1 About this document
1.1 Function ... 4
1.2 Target group ... 4
1.3 Symbols used ... 4

2 For your safety
2.1 Authorised personnel ... 5
2.2 Appropriate use ... 5
2.3 Warning about incorrect use ... 5
2.4 General safety instructions ... 5
2.5 CE conformity ... 5
2.6 SIL qualification according to IEC 61508 ... 6
2.7 NAMUR recommendations ... 6
2.8 Environmental instructions ... 6

3 Product description
3.1 Configuration ... 7
3.2 Principle of operation ... 8
3.3 Packaging, transport and storage ... 11
3.4 Accessories and replacement parts ... 11

4 Mounting
4.1 General instructions ... 14
4.2 Mounting instructions ... 15

5 Connecting to power supply
5.1 Preparing the connection ... 23
5.2 Connecting ... 24
5.3 Wiring plan, single chamber housing ... 26
5.4 Wiring plan, double chamber housing ... 26
5.5 Double chamber housing with DIS-ADAPT ... 27
5.6 Wiring plan, Ex-d-ia double chamber housing ... 28
5.7 Wiring plan - version IP 66/IP 68, 1 bar ... 30
5.8 Supplementary electronics ... 30
5.9 Switch-on phase ... 31

6 Functional safety (SIL)
6.1 Objective ... 32
6.2 SIL qualification ... 32
6.3 Application area ... 32
6.4 Safety concept of the parameterization ... 33
6.5 Setup process ... 34

7 Set up with the display and adjustment module
7.1 Insert display and adjustment module ... 37
7.2 Adjustment system ... 38
7.3 Parameter adjustment ... 39
7.4 Saving the parameter adjustment data ... 61

8 Setup with PACTware
8.1 Connect the PC ... 62
8.2 Parameter adjustment with PACTware ... 63

44234-EN-140430

8.3 Saving the parameter adjustment data ... 64

9 Set up with other systems

9.1 DD adjustment programs ... 65
9.2 Field Communicator 375, 475 ... 65

10 Diagnostics and service

10.1 Maintenance ... 66
10.2 Diagnosis memory ... 66
10.3 Status messages ... 67
10.4 Rectify faults ... 71
10.5 Exchanging the electronics module ... 74
10.6 Exchange or shorten cable/rod ... 75
10.7 Software update ... 77
10.8 How to proceed if a repair is needed ... 77

11 Dismounting

11.1 Dismounting steps ... 78
11.2 Disposal ... 78

12 Supplement

12.1 Technical data ... 79
12.2 Dimensions ... 91

Safety instructions for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

Editing status: 2014-03-31

44234-EN-140430

1 About this document

1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained specialist personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbols used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.

Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.

Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

- **List**
  The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence of actions**
Numbers set in front indicate successive steps in a procedure.

Battery disposal
This symbol indicates special information about the disposal of batteries and accumulators.

44234-EN-140430

2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use

VEGAFLEX 86 is a sensor for continuous level measurement.

You can find detailed information about the area of application in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

2.3 Warning about incorrect use

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions

This is a state-of-the-art instrument complying with all prevailing regulations and guidelines. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

The safety approval markings and safety tips on the device must also be observed.

2.5 CE conformity

The device fulfills the legal requirements of the applicable EC guidelines. By affixing the CE marking, we confirm successful testing of the product.

You can find the CE Certificate of Conformity in the download section of our homepage.

44234-EN-140430

Electromagnetic compatibility
Instruments in four-wire or Ex-d-ia version are designed for use in an industrial environment. Nevertheless, electromagnetic interference from electrical conductors and radiated emissions must be taken into account, as is usual with class A instruments according to EN 61326-1. If the instrument is used in a different environment, the electromagnetic compatibility to other instruments must be ensured by suitable measures.

2.6 SIL qualification according to IEC 61508

The Safety Integrity Level (SIL) of an electronic system is used to assess the reliability of integrated safety functions.

For detailed specification of the safety requirements, several SIL levels are specified according to safety standard IEC 61508. You can find detailed information in chapter "*Funsctional safety (SIL)*"

The instrument meets the specifications of IEC 61508: 2010 (Edition 2). It is qualified for single-channel operation up to SIL2. The instrument can be used homogeneously redudant up to SIL3 in multichannel architecture with HFT 1.

2.7 NAMUR recommendations

NAMUR is the automation technology user association in the process industry in Germany. The published NAMUR recommendations are accepted as the standard in field instrumentation.

The device fulfills the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment
- NE 43 – Signal level for malfunction information from measuring transducers
- NE 53 – Compatibility of field devices and display/adjustment components
- NE 107 – Self-monitoring and diagnosis of field devices

For further information see www.namur.de.

2.8 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.

Please help us fulfill this obligation by observing the environmental instructions in this manual:

- Chapter "*Packaging, transport and storage*"
- Chapter "*Disposal*"

3 Product description

3.1 Configuration

Type label

The type label contains the most important data for identification and use of the instrument:

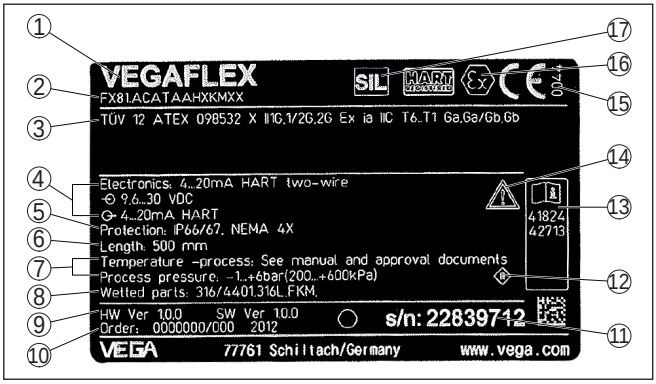

Fig. 1: Layout of the type label (example)

1 *Instrument type*
2 *Product code*
3 *Approvals*
4 *Power supply and signal output, electronics*
5 *Protection rating*
6 *Probe length*
7 *Process and ambient temperature, process pressure*
8 *Material, wetted parts*
9 *Hardware and software version*
10 *Order number*
11 *Serial number of the instrument*
12 *Symbol of the device protection class*
13 *ID numbers, instrument documentation*
14 *Reminder to observe the instrument documentation*
15 *Notified authority for CE marking*
16 *Approval directives*
17 *Marking of the safety function in SIS*

Serial number - Instrument search

The type label contains the serial number of the instrument. With it you can find the following instrument data on our homepage:

- Product code (HTML)
- Delivery date (HTML)
- Order-specific instrument features (HTML)
- Operating instructions and quick setup guide at the time of shipment (PDF)
- Order-specific sensor data for an electronics exchange (XML)
- Test certificate (PDF) - optional

Go to www.vega.com, "*VEGA Tools*" and "*Instrument search*". Enter the serial number.

Alternatively, you can access the data via your smartphone:

- Download the smartphone app "*VEGA Tools*" from the "*Apple App Store*" or the "*Google Play Store*"
- Scan the Data Matrix code on the type label of the instrument or
- Enter the serial number manually in the app

Scope of this operating instructions manual

This operating instructions manual applies to the following instrument versions:

- Hardware from 1.0.0
- Software from 1.0.0
- DTM from version 1.67.2

Versions

The instrument and the electronics version can be determined via the product code on the type label as well as on the electronics.

- Standard electronics: Type FX80H.-SIL

Scope of delivery

The scope of delivery encompasses:

- Sensor
- Documentation
  - this operating instructions manual
  - Safety Manual (SIL)
  - Test certificate measuring accuracy (optional)
  - Operating instructions manual "*Display and adjustment module*" (optional)
  - Supplementary instructions "*GSM/GPRS radio module*" (optional)
  - Supplementary instructions manual "*Heating for display and adjustment module*" (optional)
  - Supplementary instructions manual "*Plug connector for continuously measuring sensors*" (optional)
  - Ex-specific "*Safety instructions*" (with Ex versions)
  - if necessary, further certificates

3.2 Principle of operation

Application area

The VEGAFLEX 86 is a level sensor with cable or rod probe for continuous level or interface measurement, particularly suitable for applications in high temperatures up to +450 °C (842 °F).

SIL

Due to the qualification up to SIL2 or homogeneous redundant up to SIL3 (IEC 61508) the VEGAFLEX 86 is suitable for the use in safety-instrumented systems (SIS).

The safety function (SIF) can be a monitoring of the max. or min. level or a combination of both.

Functional principle - level measurement

High frequency microwave pulses are guided along a steel cable or a rod. Upon reaching the product surface, the microwave pulses are reflected. The running time is evaluated by the instrument and outputted as level.

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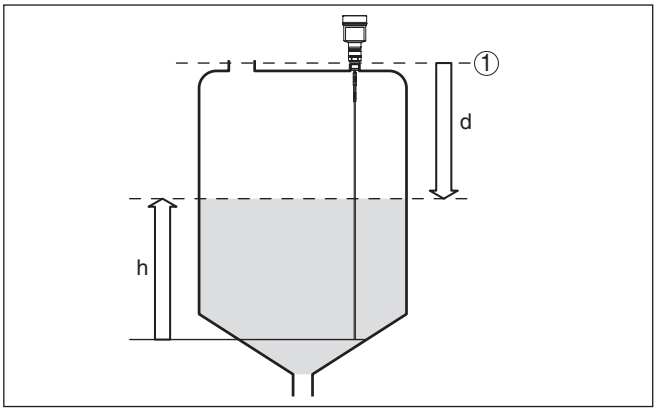


Fig. 2: Level measurement

1 Sensor reference plane (seal surface of the process fitting)
d Distance to the interface (HART value 1)
h Height - Level

Probe end tracking

To increase sensitivity, the probe is equipped with probe end tracking. In products with a low dielectric constant, this function is very helpful. This is the case, for example, in plastic granules, packing chips or in vessels with fluidized products.

Between a dielectric constant of 1.5 and 3, the function switches on, if required. As soon as the level echo can no longer be detected, probe end tracking is automatically activated. The measurement is continued with the last calculated dielectric constant.

The accuracy thus depends on the stability of the dielectric constant.

If you measure a medium with a dielectric constant below 1.5, probe end tracking is always active. In this case, you have to enter the dielectric constant of the medium. A stable dielectric constant is very important here.

Functional principle - interface measurement

High frequency microwave impulses are guided along a steel cable or rod. Upon reaching the product surface, a part of the microwave impulses is reflected. The other part passes through the upper product and is reflected by the interface. The running times to the two product layers are processed by the instrument.

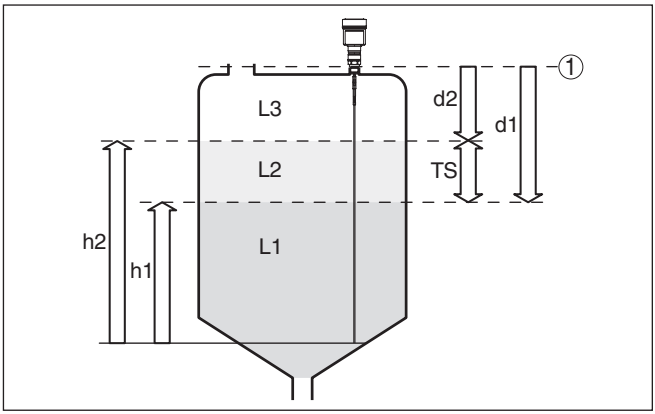


Fig. 3: Interface measurement

1 Sensor reference plane (seal surface of the process fitting)
d1 Distance to the interface (HART value 1)
d2 Distance to the level (HART value 3)
TS Thickness of the upper medium (d1 - d2)
h1 Height - Interface
h2 Height - Level
L1 Lower medium
L2 Upper medium
L3 Gas phase

Prerequisites for interface measurement

Upper medium (L2)

- The upper medium must not be conductive
- The dielectric constant of the upper medium or the actual distance to the interface must be known (input required). Min. dielectric constant: 1.6. You can find a list of dielectric constants on our home page: www.vega.com.
- The composition of the upper medium must be stable, no varying products or mixtures
- The upper medium must be homogeneous, no stratifications within the medium
- Min. thickness of the upper medium 50 mm (1.97 in)
- Clear separation from the lower medium, emulsion phase or detritus layer max. 50 mm (1.97 in)
- If possible, no foam on the surface

Lower medium (L1)

- The dielectric constant must be 10 higher than the dielectric constant of the upper medium, preferably electrically conductive. Example: upper medium dielectric constant 2, lower medium at least dielectric constant 12.

Gas phase (L3)

- Air or gas mixture
- Gas phase - dependent on the application, gas pahse does not always exist (d2 = 0)

44234-EN-140430

Output signal

The instrument is always preset to the application "*Level measurement*".

For the interface measurement, you can select the requested output signal with the setup.

3.3 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter "*Supplement - Technical data - Ambient conditions*"
- Relative humidity 20 … 85 %

3.4 Accessories and replacement parts

PLICSCOM

The display and adjustment module PLICSCOM is used for measured value indication, adjustment and diagnosis. It can be inserted into the sensor or the external display and adjustment unit and removed at any time.

You can find further information in the operating instructions "*Display and adjustment module PLICSCOM*" (Document-ID 27835).

VEGACONNECT

The interface adapter VEGACONNECT enables the connection of communication-capable instruments to the USB interface of a PC. For parameter adjustment of these instruments, the adjustment software PACTware with VEGA-DTM is required.

You can find further information in the operating instructions "*Interface adapter VEGACONNECT*" (Document-ID 32628).

VEGADIS 81

The VEGADIS 81 is an external display and adjustment unit for VEGA plics® sensors.

For sensors with double chamber housing the interface adapter "*DIS-ADAPT*" is also required for VEGADIS 81.

You can find further information in the operating instructions "*VEGADIS 81*" (Document-ID 43814).

DIS-ADAPT

The adapter "*DIS-ADAPT*" is an accessory part for sensors with double chamber housings. It enables the connection of VEGADIS 81 to the sensor housing via an M12 x 1 plug.

You can find further information in the supplementary instructions "*Adapter DISADAPT*" (Document-ID 45250).

VEGADIS 62

VEGADIS 62 is suitable for measured value indication and adjustment of sensors with HART protocol. It is looped into the 4 … 20 mA/HART signal cable.

You can find further information in the operating instructions "*VEGADIS 62*" (Document-ID 36469).

Protective cap

The protective cover protects the sensor housing against soiling and intense heat from solar radiation.

You will find additional information in the supplementary instructions manual "*Protective cover*" (Document-ID 34296).

Flanges

Screwed flanges are available in different versions according to the following standards: DIN 2501, EN 1092-1, BS 10, ANSI B 16.5, JIS B 2210-1984, GOST 12821-80.

You can find additional information in the supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*" (Document-ID 31088).

Electronics module

The electronics module VEGAFLEX 80 series - SIL is a replacement part for TDR sensors of the VEGAFLEX 80 series with SIL qualification. Electronics modules with SIL qualification must only be replaced by identical electronics modules.

You can find further information in the operating instructions manual "*Electronics module VEGAFLEX series 80*".

Display and adjustment module with heating

The display and adjustment module can be optionally replaced by a display and adjustment module with heating function.

You can use this display and adjustment module in an ambient temperature range of -40 … +70 °C.

You can find further information in the operating instructions "*Display and adjustment module with heating*" (Document-ID 31708).

44234-EN-140430

Rod extension

If you are using an instrument with rod version, you can extend the rod probe individually with curved segments and rod extensions of different lengths.

All extensions used must not exceed a total length of 6 m (19.7 ft).

The extensions are available in the following lengths:

Rod: ø 16 mm (0.63 in)

- Basic segments: 20 … 5900 mm (0.79 … 232 in)
- Rod segments: 20 … 5900 mm (0.79 … 232 in)
- Curved segments: 100 x 100 mm (3.94 … 3.94 in)

You can find further information in the operating instructions manual "*Rod extension VEGAFLEX series 80*".

Bypass tube

The combination of a bypass tube and a VEGAFLEX 86 enables continuous level measurement outside the vessel. The bypass consists of a standpipe which is mounted as a communicating container on the side of the vessel via two process fittings. This kind of mounting ensures that the level in the standpipe and the level in the vessel are the same.

The length and the process fittings can be configured individually. No different connection versions available.

You can find further information in the operating instructions manual "*Bypass tube VEGAPASS 81*".

Spacer

If you mount the VEGAFLEX 86 in a bypass tube or standpipe, you have to avoid contact to the bypass tube by using a spacer at the probe end.

You can find additional information in the operating instructions manual "*Centering*".

4 Mounting

4.1 General instructions

Screwing in

On instruments with process fitting thread, the hexagon must be tightened with a suitable screwdriver. Wrench size see chapter "*Dimensions*".

Warning:
The housing must not be used to screw the instrument in! Applying tightening force can damage internal parts of the housing.

Protection against moisture

Protect your instrument against moisture penetration through the following measures:

- Use the recommended cable (see chapter "*Connecting to power supply*")
- Tighten the cable gland
- Turn the housing in such a way that the cable gland points downward
- Loop the connection cable downward in front of the cable gland

This applies particularly to:

- Outdoor mounting
- Installations in areas where high humidity is expected (e.g. through cleaning processes)
- Installations on cooled or heated vessels

Protective caps

In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The openings for the cable glands are therefore covered with red protective caps as transport protection.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

The suitable cable glands and blind plugs come with the instrument.

Suitability for the process conditions

Make sure that all parts of the instrument exposed to the process are suitable for the existing process conditions.

These are mainly:

- Active measuring component
- Process fitting
- Process seal

Process conditions are particularly:

- Process pressure
- Process temperature
- Chemical properties of the medium
- Abrasion and mechanical influences

You can find the specifications of the process conditions in chapter "*Technical data*" as well as on the type label.

44234-EN-140430

4.2 Mounting instructions

Installation position

Mount VEGAFLEX 86 in such a way that the distance to vessel installations or to the vessel wall is at least 300 mm (12 in). In non-metallic vessels, the distance to the vessel wall should be at least 500 mm (19.7 in).

During operation, the probe must not touch any installations or the vessel wall. If necessary, fasten the probe end.

In vessels with conical bottom it can be advantageous to mount the sensor in the center of the vessel, as measurement is then possible nearly down to the lowest point of the bottom. Keep in mind that measurement all the way down to the tip of the probe may not be possible. The exact value of the min. distance (lower dead band) is stated in chapter "*Technical data*".

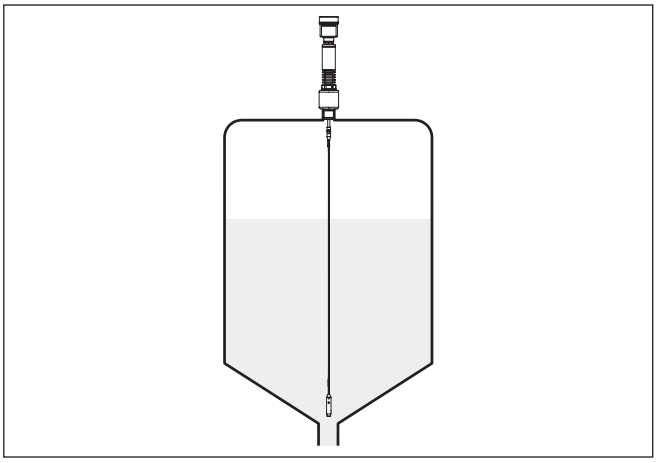


Fig. 4: Vessel with conical bottom

Type of vessel

Plastic vessel/Glass vessel

The guided microwave principle requires a metallic surface on the process fitting. Therefore, in plastic vessels, etc., use an instrument version with flange (from DN 50) or place a metal sheet (ø > 200 mm/8 in) beneath the process fitting when screwing it in.

Make sure that the plate has direct contact with the process fitting.

When installing rod or cable probes in vessels without metal walls, e.g. in plastic vessels, the measured value can be influenced by strong electromagnetic fields (emitted interference according to EN 61326: class A). In this case, use a probe with coaxial version.

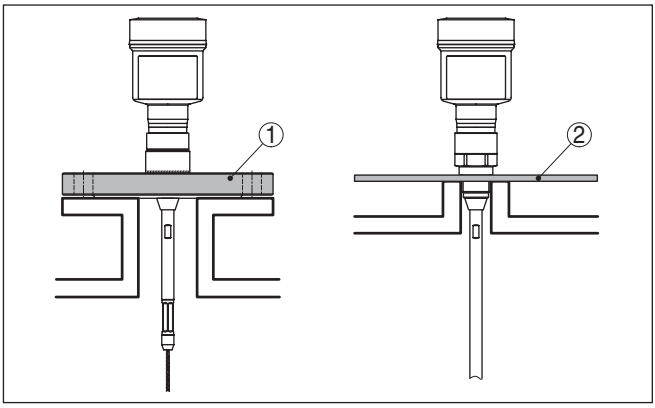


Fig. 5: Installation in non-metallic vessel

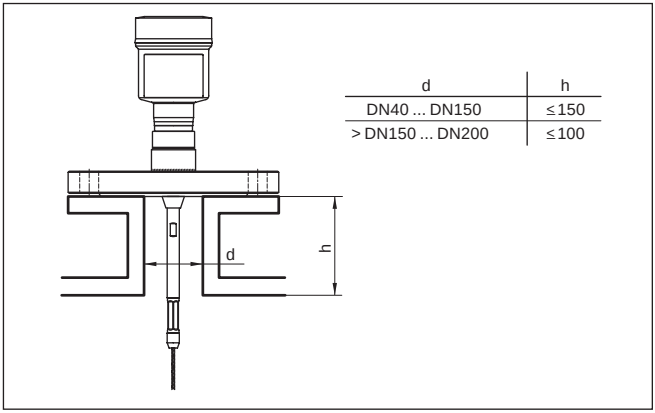
1 Flange
2 Metal sheet

Socket

If possible, avoid sockets. Mount the sensor flush with the vessel top. If this is not possible, use short sockets with small diameter.

Higher sockets or sockets with a bigger diameter can generally be used. They can, however, increase the upper blocking distance (dead band). Check if this is relevant for your measurement.

In such cases, always carry out a false signal suppression after installation. You can find further information under "*Setup procedure*".



d	h
DN40 ... DN150	≤150
> DN150 ... DN200	≤100

Fig. 6: Mounting socket

When welding the socket, make sure that the socket is flush with the vessel top.

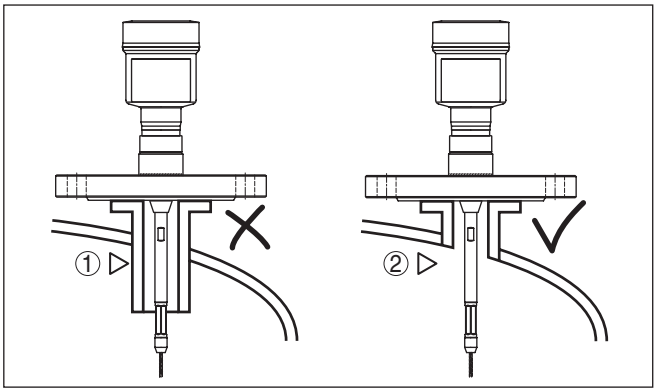


Fig. 7: Socket must be installed flush

1 Unfavourable installation
2 Socket flush - optimum installation

Welding work

Before beginning the welding work, remove the electronics module from the sensor. By doing this, you avoid damage to the electronics through inductive coupling.

Inflowing medium

Do not mount the instruments in or above the filling stream. Make sure that you detect the product surface, not the inflowing product.

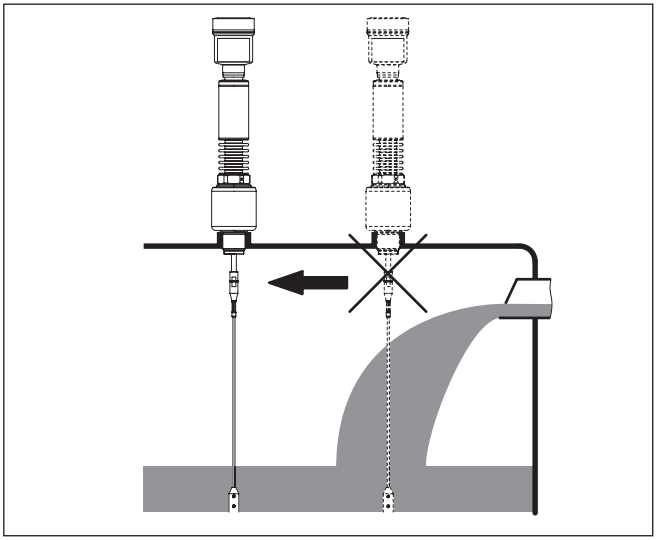


Fig. 8: Mounting of the sensor with inflowing medium

Measuring range

The reference plane for the measuring range of the sensors is the sealing surface of the thread or flange.

Keep in mind that a min. distance must be maintained below the reference plane and possibly also at the end of the probe - measurement in these areas is not possible (dead band). The length of the cable can be used all the way to the end only when measuring conductive products. These blocking distances for different mediums are listed in chapter "*Technical data*". Keep in mind for the adjustment that the default setting for the measuring range refers to water.

Pressure

The process fitting must be sealed if there is gauge or low pressure in the vessel. Before use, check if the seal material is resistant against the measured product and the process temperature.

The max. permissible pressure is specified in chapter "*Technical data*" or on the type label of the sensor.

Standpipes or bypass tubes

Standpipes or bypass tubes are normally metal tubes with a diameter of 30 … 200 mm (1.18 … 7.87 in). In measurement technology, such a tube corresponds to a coax probe. It does not matter if the standpipe is perforated or slotted for better mixing. Lateral inlets in bypass tubes also do not influence the measurement.

Measuring probes can be mounted in bypass tubes up to DN 200.

For bypass tubes, select the probe length such that the blocking distance (dead band) of the probe is above or below the lateral filling openings. You can thus measure the complete range of the medium in the bypass tube. When designing the bypass tube, keep the blocking distance of the probe in mind and select the length above the upper lateral filling opening accordingly.

Microwaves can penetrate many plastics. For process technical reasons, plastic standpipes are problematic. If durability is no problem, then we recommend the use of metal standpipes.

When the VEGAFLEX 86 is used in standpipes or bypass tubes, contact with the tube wall must be avoided. We recommend for this purpose a cable probe with centering weight.

With rod probes, a spacer is generally not required. However, if there is a risk of the rod probe being pressed against the tube wall by inflowing medium, you should mount a spacer at the probe end to avoid contact with the tube wall. In the case of cable probes, the cable can be strained.

Keep in mind that buildup can form on the spacers. Strong buildup can influence the measurement.

44234-EN-140430

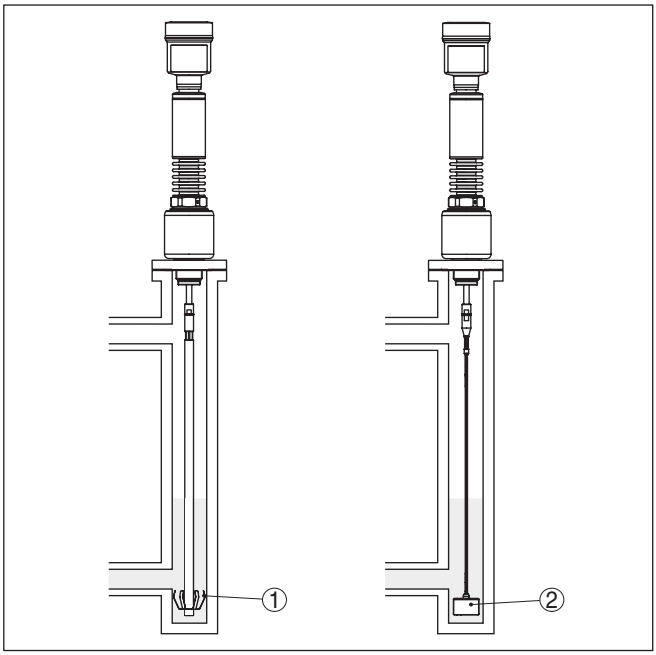


Fig. 9: Position of the spacer or centering weight

1 Rod probe with spacer (steel)
2 Cable probe with centering weight

Note:
Measurement in a standpipe is not recommended for extremely adhesive products.

Instructions for the measurement:

- The 100 % point should not be above the upper tube connection to the vessel
- The 0 % point should not be below the lower tube connection to the vessel
- A false signal suppression with installed sensor is generally recommended to achieve maximum possible accuracy.

Mounting in the vessel insulation

Instruments for a temperature range up to 280 °C or up to 450 °C have a distance piece between process fitting and electronics housing. Ths distance piece is used for thermal decoupling of the electronics against high process temperatures.

Information:
The distance piece must only be incorporated up to max. 50 mm (2 in) in the vessel isolation. Only then, a reliable temperature decoupling is guaranteed.

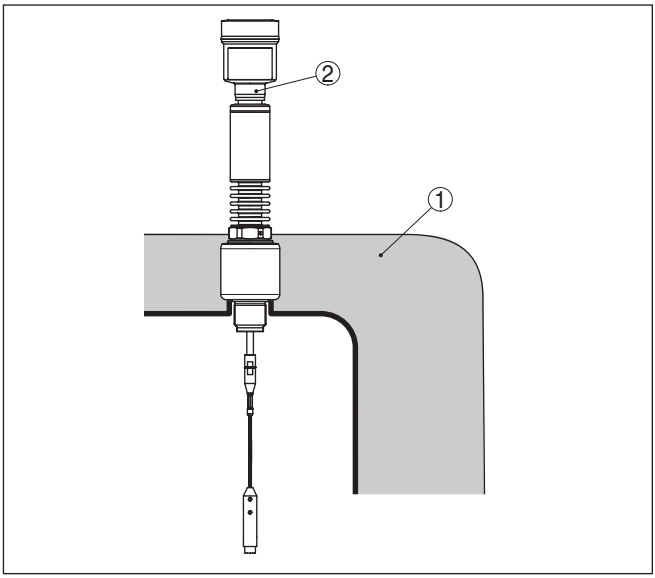


Fig. 10: Mounting the instrument on insulated vessels.

1 Temperature insulation
2 Ambient temperature on the housing

Fasten

If there is a risk of the cable probe touching the vessel wall during operation due to product movements or agitators, etc., the measuring probe should be securely fixed.

In the gravity weight there is an internal thread (M8), e.g. for an eye-bolt (optional) - (article no. 2.1512).

Make sure that the probe cable is not completely taut. Avoid tensile loads on the cable.

Avoid undefined vessel connections, i.e. the connection must be either grounded reliably or isolated reliably. Any undefined change of this requirement can lead to measurement errors.

If there is a danger of the rod probe touching the vessel wall, then the probe must be fastened at the bottom end.

Keep in mind that below the fastening, a measurement is not possible.

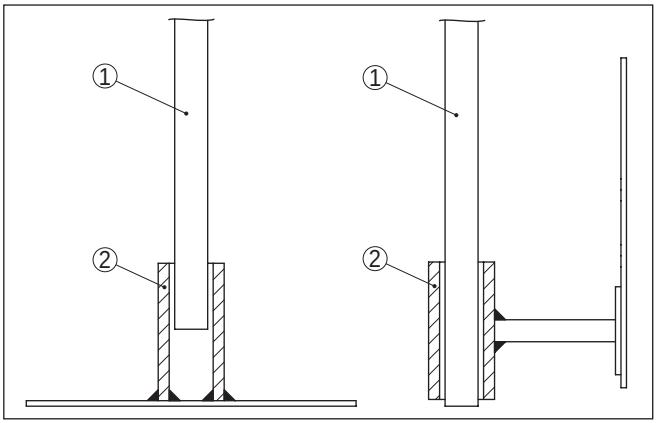


Fig. 11: Fasten the probe

1 Measuring probe
2 Retaining sleeve

Lateral installation

In case of difficult installation conditions, the probe can be also mounted laterally. For this purpose, adapt the rod with rod extensions or bow-shaped segments.

Let the probe length determine automatically by the instrument to compensate the resulting running time changes.

The determine probe length can deviate from the actual probe length when using bow-shaped segments.

If installations such as struts, ladders, etc. exist on the vessel wall, then the probe should have a distance to the vessel wall of at least 300 mm (11.81 in).

You can find further information in the supplementary instructions of the rod extension.

Rod extension

In case of difficult installation conditions, for example in a socket, the probe can be adapted respectively with a rod extension.

Let the probe length determine automatically by the instrument to compensate the resulting running time changes.

You can find further information in the supplementary instructions of the rod extension.

Steam boiler applications

Vapours, superimposed gases, high pressures and temperature differences can change the spreading speed of radar impulses.

There are two possibilities to correct these deviations.

Corrective value in the process control system

In the technical data under "Influence of superimposed gas and pressure on accuracy" you can find a table with deviation values in some typical gases or in steam.

In the control system (DCS) you can correct the measurement results of the VEGAFLEX 86 with these values.

The prerequisite is constant temperature and pressure in the vessel.

Automatic correction via the reference distance

The VEGAFLEX 86 can be equipped optionally with a running time correction via reference distance. The probe can carry out an automatic running time correction with it.

Probes with reference distance can only be used when mounting in standpipes or bypass tubes.

The min. length of the probe is 1000 mm (39.4 in).

The reference distance must not be overfilled. The upper dead band is hence 450 mm (17.7 in).

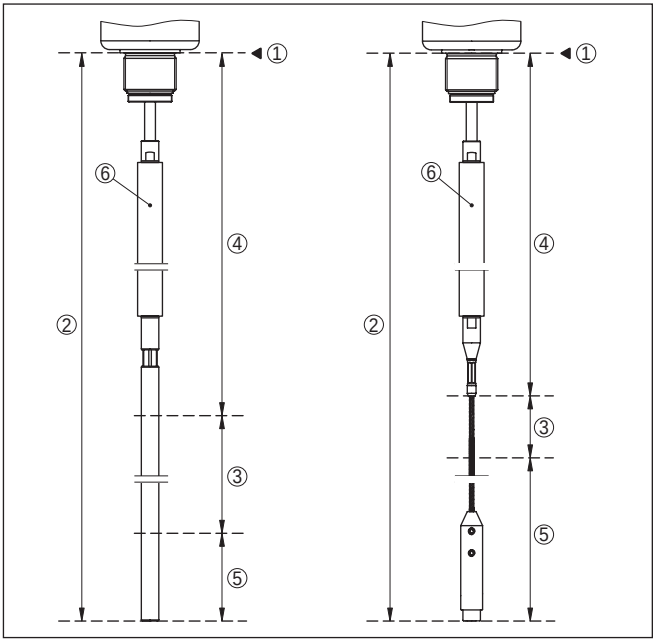


Fig. 12: Measuring ranges - VEGAFLEX 86 with steam compensation

1 Reference plane
2 Probe length L
3 Measuring range
4 Upper dead zone with steam compensation = 450 mm (17.7 in)
5 Lower dead band
6 Reference measurement distance to steam compensation

5 Connecting to power supply

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltage surges are expected, overvoltage arresters should be installed

Voltage supply

Power supply and current signal are carried on the same two-wire cable. The operating voltage can differ depending on the instrument version.

The data for power supply are specified in chapter "*Technical data*".

Provide a reliable separation between the supply circuit and the mains circuits according to DIN EN 61140 VDE 0140-1.

Keep in mind the following additional factors that influence the operating voltage:

- Lower output voltage of the power supply unit under nominal load (e.g. with a sensor current of 20.5 mA or 22 mA in case of fault)
- Influence of additional instruments in the circuit (see load values in chapter "*Technical data*")

Connection to signal conditioning instruments

The signal conditioning instruments VEGAMET and VEGASCAN have digital sensor recognition. When connecting VEGAFLEX 86, an up-to-date version of the signal conditioning instrument software is required. For a software update go to "www.vega.com/downloads" and "*Software*".

Connection cable

The instrument is connected with standard two-wire cable without screen. If electromagnetic interference is expected which is above the test values of EN 61326-1 for industrial areas, screened cable should be used.

Use cable with round cross section for instruments with housing and cable gland. To ensure the seal effect of the cable gland (IP protection rating), find out which cable outer diameter the cable gland is suitable for.

Use a cable gland fitting the cable diameter.

Cable gland ½ NPT

With plastic housing, the NPT cable gland or the Conduit steel tube must be screwed without grease into the threaded insert.

Max. torque for all housings see chapter "*Technical data*".

Cable screening and grounding

If screened cable is required, we recommend connecting the cable screen on both ends to ground potential. In the sensor, the screen must be connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the ground potential (low impedance).

With Ex systems, the grounding is carried out according to the installation regulations.

In electroplating and CCP systems (cathodic corrosion protection) it must be taken into account that significant potential differences exist. This can lead to unacceptably high shield currents if the cable shield is grounded at both ends.

Information:
The metallic parts of the instrument (process fitting, transmitter, concentric tube, etc.) are conductively connected with the inner and outer ground terminal on the housing. This connection exists either directly via connecting metallic parts or, in case of instruments with external electronics, via the screen of the special connection cable.

You can find specifications on the potential connections inside the instrument in chapter "*Technical data*".

5.2 Connecting

Connection technology

The voltage supply and signal output are connected via the spring-loaded terminals in the housing.

Connection to the display and adjustment module or to the interface adapter is carried out via contact pins in the housing.

Information:
The terminal block is pluggable and can be removed from the electronics. To do this, lift the terminal block with a small screwdriver and pull it out. When reinserting the terminal block, you should hear it snap in.

Connection procedure

Proceed as follows:

1. Unscrew the housing cover
2. If a display and adjustment module is installed, remove it by turning it slightly to the left.
3. Loosen compression nut of the cable entry gland
4. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
5. Insert the cable into the sensor through the cable entry

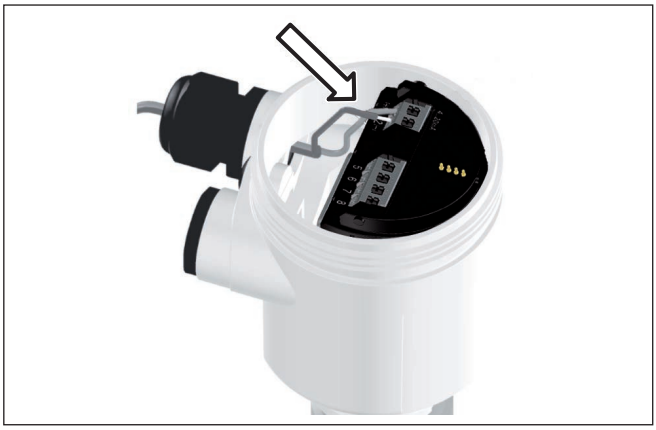


Fig. 13: Connection steps 5 and 6 - Single chamber housing

Fig. 14: Connection steps 5 and 6 - Double chamber housing

6. Insert the wire ends into the terminals according to the wiring plan

Information:
Solid cores as well as flexible cores with wire end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the terminal from above with a small screwdriver, the terminal opening is then free. When the screwdriver is released, the terminal closes again.

You can find further information on the max. wire cross-section under "*Technical data/Electromechanical data*"

7. Check the hold of the wires in the terminals by lightly pulling on them
8. Connect the screen to the internal ground terminal, connect the outer ground terminal to potential equalisation

9. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
10. Reinsert the display and adjustment module, if one was installed
11. Screw the housing cover back on

The electrical connection is finished.

5.3 Wiring plan, single chamber housing

The following illustration applies to the non-Ex, Ex-ia and Ex-d version.

Electronics and terminal compartment

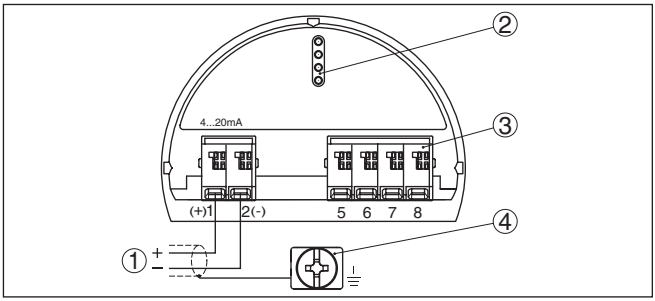


Fig. 15: Electronics and terminal compartment, single chamber housing

1 Voltage supply, signal output
2 For display and adjustment module or interface adapter
3 For external display and adjustment unit
4 Ground terminal for connection of the cable screen

5.4 Wiring plan, double chamber housing

The following illustrations apply to the non-Ex as well as to the Ex-ia version.

Electronics compartment

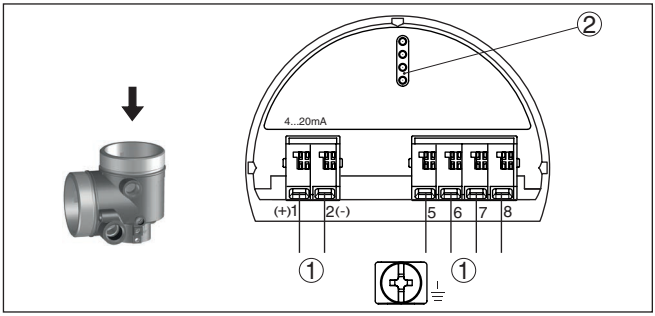


Fig. 16: Electronics compartment, double chamber housing

1 Internal connection to the connection compartment
2 For display and adjustment module or interface adapter

Terminal compartment

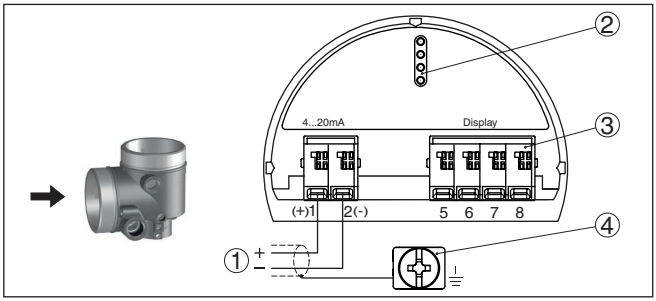


Fig. 17: Terminal compartment, double chamber housing

1 Voltage supply, signal output
2 For display and adjustment module or interface adapter
3 For external display and adjustment unit
4 Ground terminal for connection of the cable screen

Information:
The use of an external display and adjustment unit and a display and adjustment module in parallel in the connection compartment is not supported.

5.5 Double chamber housing with DIS-ADAPT

Electronics compartment

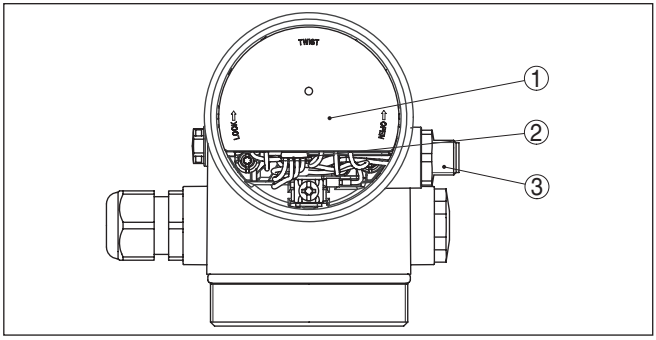


Fig. 18: View to the electronics compartment with DISADAPT for connection of the external display and adjustment unit

1 DIS-ADAPT
2 Internal plug connection
3 Plug connector M12 x 1

Assignment of the plug connector

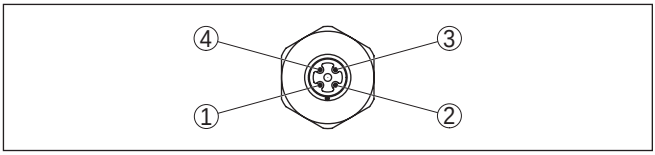


Fig. 19: View to the plug connector M12 x 1

1 Pin 1
2 Pin 2
3 Pin 3
4 Pin 4

Contact pin	Colour connection cable in the sensor	Terminal, electronics module
Pin 1	Brown	5
Pin 2	White	6
Pin 3	Blue	7
Pin 4	Black	8

5.6 Wiring plan, Ex-d-ia double chamber housing

Electronics compartment

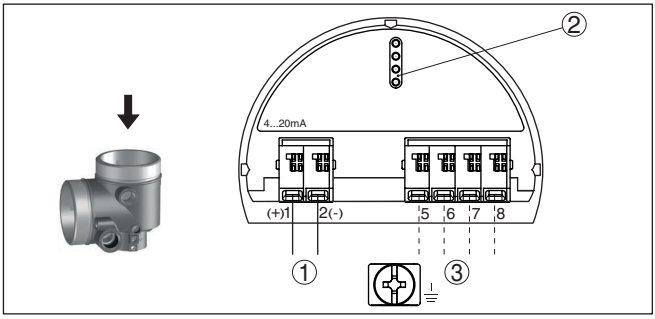


Fig. 20: Electronics compartment, double chamber housing

1 Internal connection to the connection compartment
2 For display and adjustment module or interface adapter
3 Internal connection to the plug connector for external display and adjustment unit (optional)

Terminal compartment

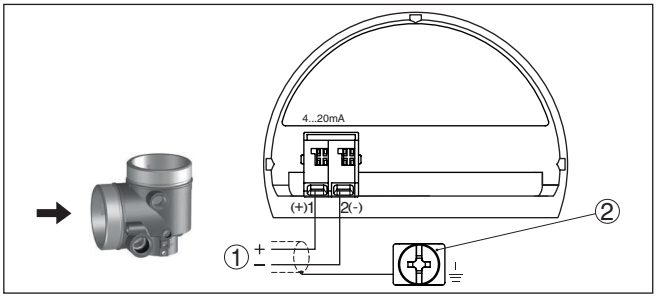


Fig. 21: Connection compartment, double chamber housing Ex d ia

1 Voltage supply, signal output
2 Ground terminal for connection of the cable screen

Electronics compartment

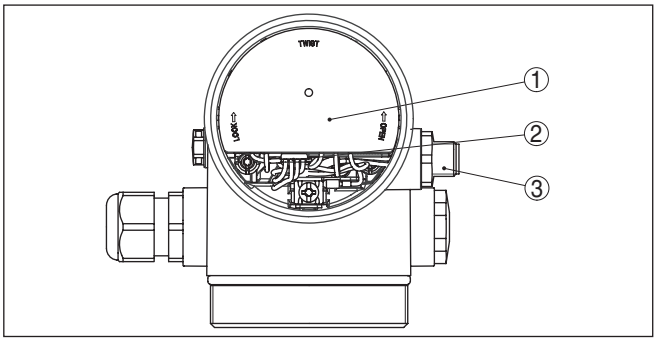


Fig. 22: View to the electronics compartment with DISADAPT for connection of the external display and adjustment unit

1 DIS-ADAPT
2 Internal plug connection
3 Plug connector M12 x 1

Assignment of the plug connector

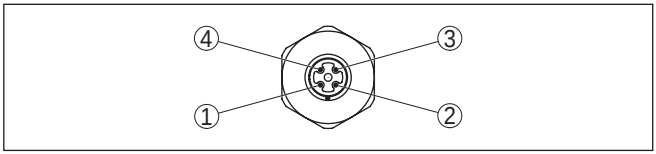


Fig. 23: View to the plug connector M12 x 1

1 Pin 1
2 Pin 2
3 Pin 3
4 Pin 4

Contact pin	Colour connection cable in the sensor	Terminal, electronics module
Pin 1	Brown	5

Contact pin	Colour connection cable in the sensor	Terminal, electronics module
Pin 2	White	6
Pin 3	Blue	7
Pin 4	Black	8

5.7 Wiring plan - version IP 66/IP 68, 1 bar

Wire assignment, connection cable

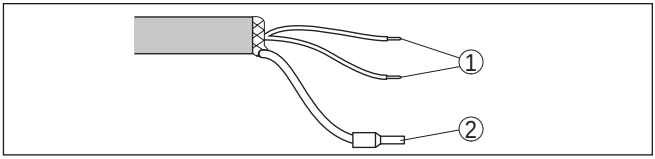


Fig. 24: Wire assignment in permanently connected connection cable

1 brown (+) and blue (-) to power supply or to the processing system
2 Shielding

5.8 Supplementary electronics

Supplementary electronics - Additional current output

You can use the supplementary electronics - additional current output to provided a second measured value.

Both current outputs are passive and need a power supply.

SIL The additional current output (II) cannot be used in safety-instrumented systems according to SIL.

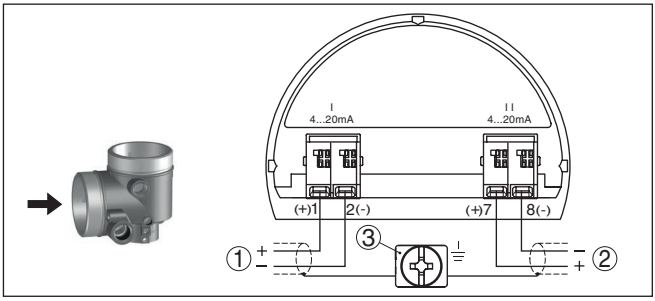


Fig. 25: Connection compartment double chamber housing, supplementary electronics - additional current output

1 First current output (I) - Voltage supply and signal output (HART)
2 Second current output (II) - Voltage supply and signal output (without HART)
3 Ground terminal for connection of the cable screen

Supplementary electronics - Radio module PLICSMOBILE

The radio module PLICSMOBILE is an external GSM/GPRS radio unit for transmission of measured values and for remote parameter adjustment.

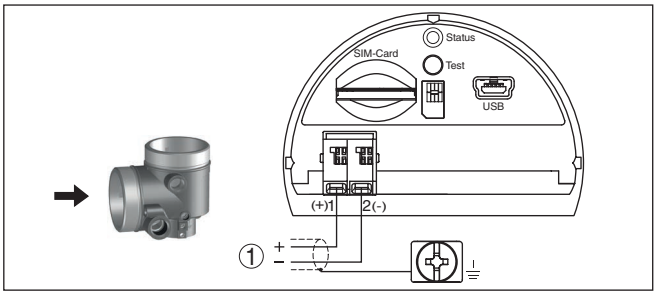


Fig. 26: Radio module PLICSMOBILE integrated in the connection compartment

1 Voltage supply

You can find detailed information on connection in the supplementary instructions "*PLICSMOBILE GSM/GPRS radio module*".

5.9 Switch-on phase

After connecting the instrument to power supply or after a voltage recurrence, the instrument carries out a self-check for approx. 30 s:

- Internal check of the electronics
- Indication of the instrument type, hardware and software version, measurement loop name on the display or PC
- Indication of the status message "*F 105 Determine measured value*" on the display or PC
- The output signal jumps to the set fault current

As soon as a plausible measured value is found, the corresponding current is outputted to the signal cable. The value corresponds to the actual level as well as the settings already carried out, e.g. factory setting.

6 Functional safety (SIL)

6.1 Objective

SIL

In case of dangerous failures, processing facilities and machines can cause risks for persons, environment and property. The risk of such failures must be judged by the plant operator. Dependent thereon are measures for risk reduction through error prevention, error detection and fault control.

The part of plant safety depending on the correct functioning of safety-related components for risk reduction is called functional safety. Components used in such safety-instrumented systems (SIS) must therefore execute their intended function (safety function) with a defined high probability.

The safety requirements for such components are described in the international standards IEC 61508 and 61511 (IEC 61062 - Machines), which set the standard for uniform and comparable judgement of instrument and plant or machine safety and hence contribute to worldwide legal certainty. Depending on the degree of required risk reduction, we distinguish between four safety levels, from SIL1 for low risk to SIL4 for very high risk (SIL = Safety Integrity Level).

6.2 SIL qualification

Additional characteristics and requirements

When developing instruments which can be used in safety-instrumented systems, the focus is on avoiding systematical as well as determining and controlling random errors.

Here the most important characteristics and requirements from the perspective of functional safety according to IEC 61508 (Edition 2):

- Internal monitoring of safety-relevant circuit parts
- Extended standardization of the software development
- In case of failure, switching of the safety-relevant outputs to a defined safe state
- Determination of the failure probability of the defined safety function
- Reliable parameterization with non-safe user environment
- Proof test

The SIL qualification of components is specified in a manual for functional safety (Safety Manual). Here, you can find all safety-relevant characteristics and information required by the user and planner for planning and operating the safety-relevant system. This document is attached to each instrument with SIL rating and can be also retrieved via the serial number search on our homepage.

6.3 Application area

The instrument can be used for point level detection or level measurement of liquids and bulk solids in safety-instrumented systems (SIS) according to IEC 61508, IEC 61511 and IEC 61062. Take note of the specifications in the Safety Manual.

The following inputs/outputs are permitted:

44234-EN-140430

- 4 … 20 mA current output

6.4 Safety concept of the parameterization

Tool for operation and parameterization

The following tools are permitted for parameterization of the safety function:

- The integrated display and adjustment unit for on-site adjustment
- The DTM suitable for the signal conditioning instrument in conjunction with an adjustment software according to the FDT/DTM standard, e. g. PACTware

Note:
For operation of the VEGAFLEX 86 the DTM Collection version 1.67.2 or higher is required. The modification of safety-relevant parameters is only possible with active connection to the instrument (online mode).

Safety parameterization

To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified after they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access. This concept applies to the adjustment on the instrument but also to adjustment with PACTware with DTM.

Safety-relevant parameters

For protection against unwanted or unauthorzed adjustment, the set parameters must be barred from unauthorized access. For this reason, the instrument is shipped in locked condition. The PIN in delivery status is "0000".

When shipped with a specific parameter adjustment, the instruments are accompanied by a list with the values deviating from the basic setting. By entering the serial number, the list is available as a download under "*www.vega.com/VEGA-Tools*".

All safety-relevant parameters must be verified after a change.

The parameter settings of the measurement loop must be documented. You can find a list of all safety-relevant paramters in the shipping status in chapter "*Setup with the display and adjustment module*" under "*Additional settings - Reset*". In addition, a list of the safety-relevant parameters can be stored and printed via PACTware/DTM.

Release adjustment

For each parameter change, the instrument must be unlocked via a PIN (see chapter "*Setup steps - Lock adjustment*"). The device status is indicated by the symbol of an unlocked or locked padlock.

In delivery status, the PIN is **0000**.

Unsafe device status

Warning:
If adjustment is enabled, the safety function must be considered as unreliable. This applies until the parameterization is terminated correctly. If necessary, other measures must be taken to maintain the safety function.

Change parameter

All parameters changed by the operator are automatically stored temporarily so that they can be verified in the next step.

Verify parameters/Lock adjustment

After setup, the modified parameters must be verified (confirm the correctness of the parameters). To do this, you first have to enter the PIN. Here the adjustment is locked automatically. Then you carry out a comparison of two character strings. You must confirm that the character strings are identical. This is used to check the character presentation.

Then you confirm that the serial number of your instrument has been carried over correctly. This is used to check device communication.

Then, all modified parameters that have to be confirmed are listed. After this process is terminated, the safety function is again ensured.

Incomplete process

Warning:
If the described process was not carried out completely or correctly (e.g. interruption or voltage loss), the instrument remains in the released and hence unsafe status.

Instrument reset

Warning:
In case of a reset to basic settings, all safety-relevant parameters will also be reset to default. Therefore all safety-relevant parameters must be checked or readjusted.

6.5 Setup process

Operating sequence
A parameter change with SIL qualified instruments must always be carried out as follows.

- Release adjustment
- Change parameter
- Lock adjustment and verify modified parameters

Start: Safe operating state

The setup must be carried out according to an exactly specified pattern.

Generally the instrument is in safe operating state before the adjustment is released.

Release adjustment

Each parameter change requires the release of the instrument through a PIN (see chapter "*Setup steps - Lock adjustment*").

In delivery status, the PIN is **0000**.

Change parameter

Set up the VEGAFLEX 86 according to the specification in this operating instructions and the Safety Manual.

Setup - Function test

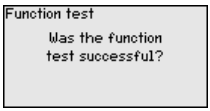
When locking the adjustment, the instrument checks the data of the measurement loop and decides on the basis of the evaluation results if a function test is required.

Function test not required
If the parameter check was successful, the adjustment is locked automatically and the instrument is again in safe operating state.

Setup is then finished.

Function test required

Should a function test be necessary, the following message is displayed on the display and adjustment module. The adjustment software also signals that a function test is required.



If a function test is required, the switching point or the range must be controlled with the original medium. For this purpose, you have to decide for your application which condition is potentially critical.

Function test

During a function test, you have to test the safety function of the instrument in the vessel with the original medium.

For this purpose, you should know the filling height of the vessel as well as the min. and max. levels respectively for 4 and 20 mA. You then can calculate the respective output current.

Measure the output current of VEGAFLEX 86 with a suitable multimeter and compare the measured output current with the calculated output current.

SIL If you have to interrupt the function, you can leave the VEGAFLEX 86 in the respective situation.

As long as VEGAFLEX 86 is powered, the display and adjustment module remains in the currently set adjustment menu.

To interrupt the function test, you have to push the button "*ESC*".

If you carry out the function test by means of the "*PACTware*" software, you can store the previously performed tests and continue from there later on.

If you click to "*Complete*", the adjustment of the instrument is locked, but not yet verified. After conclusion of the function test, you have to restart the adjustment.

If a function test is necessary, please proceed as follows:

Mode overfill protection/dry run protection

Select the respective safety function (overfill protection/dry run protection) for your application.

1. Raise the level to directly below the switching point

   Keep a holding time of 1 minute for each level before you compare the measured value.

2. Lower the level to directly above the switching point

   Keep a holding time of 1 minute for each level before you compare the measured value.

Result

In both cases the output current must correspond to the respective level.

Measure the current output and compare the value with the calculated current value.

You have to determine the permissible deviation of the values yourself. This deviation depends on the the accuracy requirements of your measurement loop. Determine the permissible tolerance for the deviation.

Mode "Range monitoring"
If both levels are important for the safety function, you have to proceed according to the mode "Range monitoring".

1. Move the level to at least three points within the range limits.

   Keep a holding time of 1 minute for each level before you compare the measured value.
2. Move the level to a point directly above and directly below the range limits.

   Keep a holding time of 1 minute for each level before you compare the measured value.

Result

In all cases the output current must correspond to the respective level.

For this purpose, you have to measure for all levels the current output and compare the values with the calculated current values.

You have to determine the permissible deviation of the values yourself. This deviation depends on the the accuracy requirements of your measurement loop. Determine the permissible tolerance for the deviation.

Verify parameters/Lock adjustment

After setup, the modified parameters must be verified. To do this, you first have to enter the current PIN. The adjustment is then locked automatically. Then you carry out a comparison of two character strings. You must confirm that the character strings are identical. This is used to check the character presentation.

Then you confirm that the serial number of your instrument has been carried over correctly. This is used to check device communication.

Then, all modified parameters that have to be confirmed are listed. After this process is terminated, the safety function is again ensured.

7 Set up with the display and adjustment module

7.1 Insert display and adjustment module

The display and adjustment module can be inserted into the sensor and removed again at any time. You can choose any one of four different positions - each displaced by 90°. It is not necessary to interrupt the power supply.

Proceed as follows:

1. Unscrew the housing cover
2. Place the display and adjustment module in the requested position onto the electronics and turn to the right until it snaps in
3. Screw housing cover with inspection window tightly back on

Removal is carried out in reverse order.

The display and adjustment module is powered by the sensor, an additional connection is not necessary.

Fig. 27: Installing the display and adjustment module in the electronics compartment of the single chamber housing

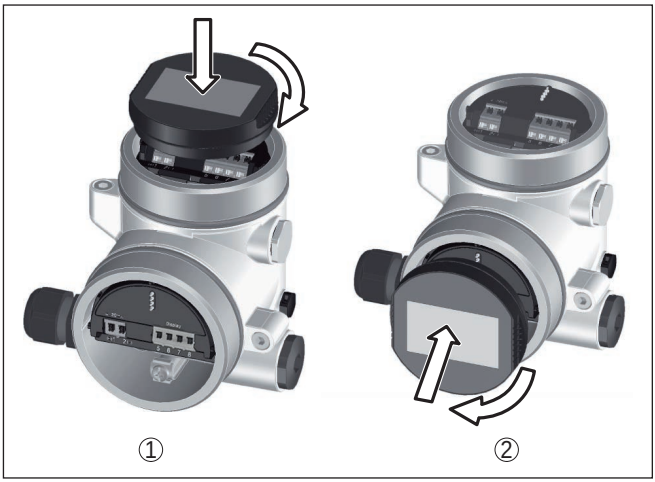


Fig. 28: Insertion of the display and adjustment module into the double chamber housing

1 In the electronics compartment
2 In the connection compartment (with Ex-d-ia version not possible)

Note:
If you intend to retrofit the instrument with a display and adjustment module for continuous measured value indication, a higher cover with an inspection glass is required.

7.2 Adjustment system

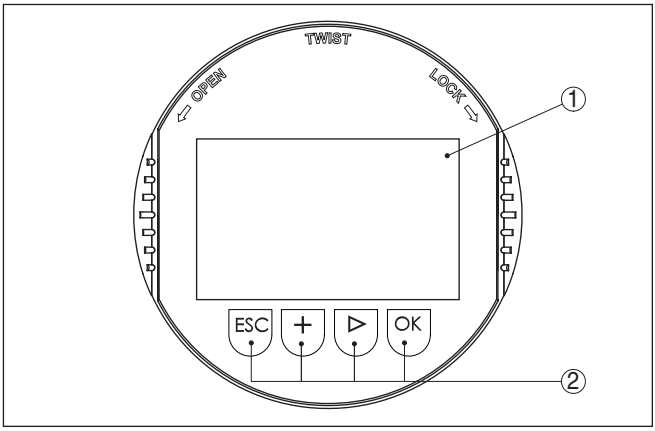


Fig. 29: Display and adjustment elements

1 LC display
2 Adjustment keys

Key functions

- ***[OK]*** key:
  – Move to the menu overview

- Confirm selected menu
- Edit parameter
- Save value

- ***[->]*** key:
  - Presentation, change measured value
  - Select list entry
  - Select editing position

- ***[+]*** key:
  - Change value of the parameter

- ***[ESC]*** key:
  - Interrupt input
  - Jump to next higher menu

Adjustment system

The sensor is adjusted via the four keys of the display and adjustment module. The LC display indicates the individual menu items. The functions of the individual keys are shown in the above illustration. Approx. 10 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with ***[OK]*** will not be saved.

Switch-on phase

After switching on, the VEGAFLEX 86 carries out a short self-test where the device software is checked.

The output signal transmits a fault signal during the switch-on phase.

The following information is displayed on the display and adjustment module during the startup procedure:

- Instrument type
- Device name
- Software version (SW-Ver)
- Hardware version (HW-Ver)

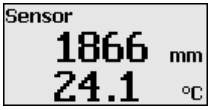
Measured value indication

With the ***[->]*** key you can move between three different indication modes.

In the first view, the selected measured value is displayed in large digits.

In the second view, the selected measured value and a corresponding bar graph presentation are displayed.

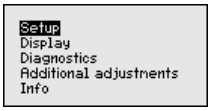
In the third view, the selected measured value as well as a second selectable value, e.g. the temperature, are displayed.



7.3 Parameter adjustment

Main menu

The main menu is divided into five sections with the following functions:



Setup: Settings, e.g. measurement loop name, medium, vessel, adjustment, signal output, device unit, false signal suppression, linearization curve

Display: Settings, e.g., for language, measured value display, lighting

Diagnosis: Information, e.g. on instrument status, pointer, measurement reliability, simulation, echo curve

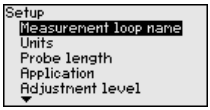
Additional adjustments: Reset, date/time, reset, copy function

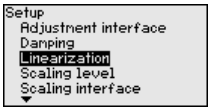
Info: Instrument name, hardware and software version, date of manufacture, instrument features

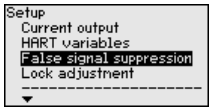
Note:
For optimum adjustment of the measuring point, the individual submenu items in the main menu item "*Setup*" should be selected one after the other and provided with the correct parameters. If possible, go through the items in the given sequence.

The procedure is described below.

The following submenu points are available:







The submenu points described below.

Operating sequence
A parameter change with SIL qualified instruments must always be carried out as follows.

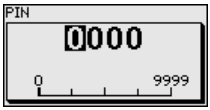
- Release adjustment
- Change parameter
- Lock adjustment and verify modified parameters

This ensures that all modified parameters were consciously changed.

Release adjustment
The instrument is shipped in locked condition.

As a protection against unintentional or unauthorized adjustment, the instrument is locked against all parameter changes in normal operating condition.

For each parameter change you have to enter the PIN of the instrument. In delivery status, the PIN is "0000".



SIL If adjustment is enabled, the safety function must be considered as unreliable. This applies until the parameterization is terminated

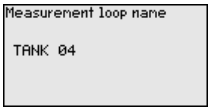
correctly. If necessary, other measures must be taken to maintain the safety function.

Setup - Measurement loop name

Here you can assign a suitable measurement loop name. Push the "***OK***" key to start the processing. With the "**+**" key you change the sign and with the "**->**" key you jump to the next position.

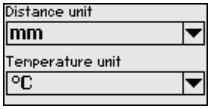
You can enter names with max. 19 characters. The character set comprises:

- Capital letters from A … Z
- Numbers from 0 … 9
- Special characters + - / _ blanks



Setup - Units

In this menu item you select the distance unit and the temperature unit.

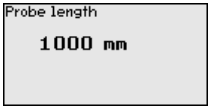


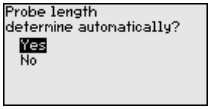
With the distance units you can choose between m, mm and ft and with the temperature units betwenn °C, °F and K.

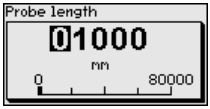
Setup - Probe length

In this menu item you can enter the probe length or have the length determined automatically by the sensor system.

When choosing "*Yes*", then the probe length will be determined automatically. When choosing "*No*", you can enter the probe length manually.

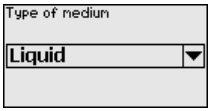


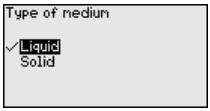




Setup - Type of medium

In this menu item you can select which type of medium you want to measure. You can choose between liquid or bulk solid.





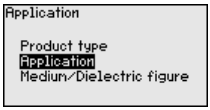
Setup - Application - Application

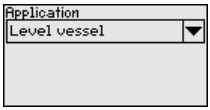
In this menu item, you can select the application. You can choose between level measurement and interface measurement. You can also choose between measurement in a vessel or in a bypass or standpipe.

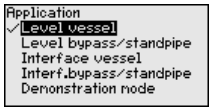
Note:
The selection of the application has a considerable influence on all other menu items. Keep in mind that as you continue with the parameter adjustment, individual menu items are only optionally available.

You have the option of choosing the demonstration mode. In this mode, the sensor ignores the parameters of the application and reacts immediately to any change.

SIL This mode is only suitable for test and demonstration purposes and must not be used in a safety-instrumented application (SIL).



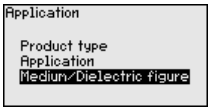


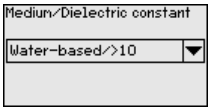


Setup - Application - Medium, dielectric constant

In this menu item, you can define the type of medium (product).

This menu item is only available if you have selected level measurement under the menu item "*Application*".





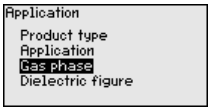
You can choose between the following medium types:

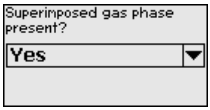
Dielectric constant	Type of medium	Examples
> 10	Water-based liquids	Acids, alcalis, water
3 … 10	Chemical mixtures	Chlorobenzene, nitro lacquer, aniline, isocyanate, chloroform
< 3	Hydrocarbons	Solvents, oils, liquid gas

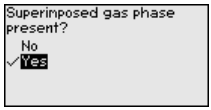
Setup - Application - Gas phase

This menu item is only available, if you have chosen interface measurement under the menu item "*Application*". In this menu item you can enter if there is a superimposed gas phase in your application.

Only set the function to "*Yes*", if the gas phase is permanently present.

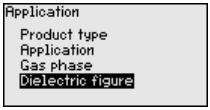


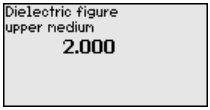


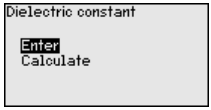


Setup - Application - Dielectric constant

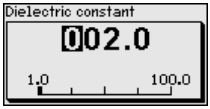
This menu item is only available if you have selected interface measurement under the menu item "*Application*". In this menu item you can choose the type of medium of the upper medium.

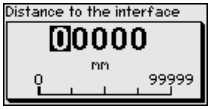






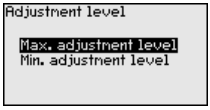
You can enter the dielectric constant of the upper medium directly or have the value determined by the instrument. To do this you have to enter the measured or known distance to the interface.

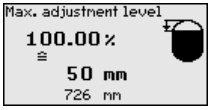




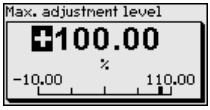
Setup - Max. adjustment Level

In this menu item you can enter the max. adjustment for the level. With interface measurement this is the maximum total level.

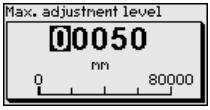




Adjust the requested percentage value with ***[+]*** and store with ***[OK]***.

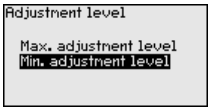


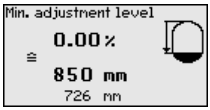
Enter the appropriate distance value in m (corresponding to the percentage value) for the full vessel. The distance refers to the sensor reference plane (seal surface of the process fitting). Keep in mind that the max. level must lie below the dead band.



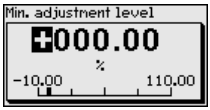
Setup - Min. adjustment Level

In this menu item you can enter the min. adjustment for the level. With interface measurement this is the minimum total level.

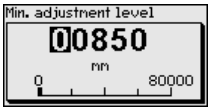




Adjust the requested percentage value with ***[+]*** and store with ***[OK]***.

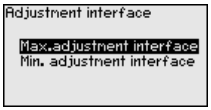


Enter the suitable distance value in m for the empty vessel (e.g. distance from the flange to the probe end) corresponding to the percentage value. The distance refers tot he sensor reference plane (seal surface of the process fitting).

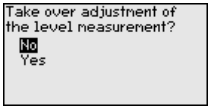


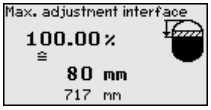
Setup - Max. adjustment - Interface

This menu item is only available if you have selected interface measurement under the menu item "*Application*".

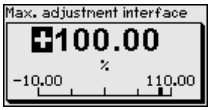


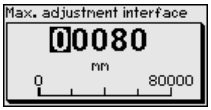
You can accept the adjustment of the level measurement also for the interface measurement. If you select "Yes", the current setting will be displayed.





If you have selected "*No*", you can enter the adjustment for the interface separately. Enter the requested percentage value.

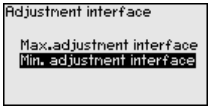


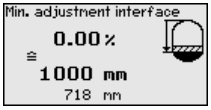


For the full vessel, enter the distance value in m matching the percentage value.

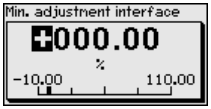
Setup - Min. adjustment - Interface

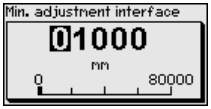
This menu item is only available if you have selected interface measurement under the menu item "*Application*". If you have selected "*Yes*" in the previous menu item (accept adjustment of the level measurement), the current setting will be displayed.





If you have selected "*No*", you can enter the adjustment for the interface measurement separately.



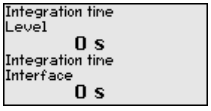


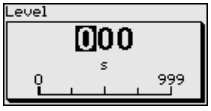
Enter the respective distance value in m for the empty vessel corresponding to the percentage value.

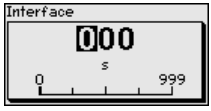
Setup - Damping

To damp process-dependent measured value fluctuations, set an integration time of 0 … 999 s in this menu item.

If you have selected interface measurement under the menu item "*Application*", you can adjust the damping for the level and the interface separately.







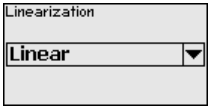
44234-EN-140430

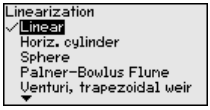
The default setting is a damping of 0 s.

Setup - Linearization

A linearization is necessary for all vessels in which the vessel volume does not increase linearly with the level - e.g. a horizontal cylindrical or spherical tank, when the indication or output of the volume is required. Corresponding linearization curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume.

The linearization applies to the measured value indication and the current output. By activating the appropriate curve, the volume percentage of the vessel is displayed correctly. If the volume should not be displayed in percent but e.g. in l or kg, a scaling can be also set in the menu item "*Display*".





Warning:
If a linearization curve is selected, the measuring signal is no longer necessarily linear to the filling height. This must be considered by the user especially when adjusting the switching point on the limit signal transmitter.

In the following, you have to enter the values for your vessel, for example the vessel height and the socket correction.

For non-linear vessel forms, enter the vessel height und the socket correction.

For the vessel height, you have to enter the total height of the vessel.

For the socket correction you have to enter the height of the socket above the upper edge of the vessel. If the socket is lower than the upper edge of the vessel, this value can also be negative.

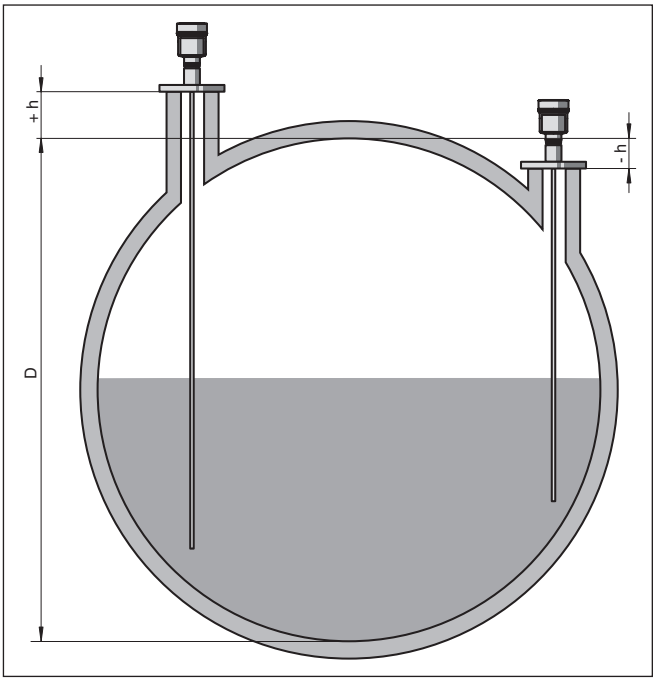
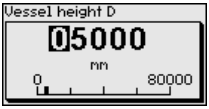
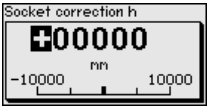
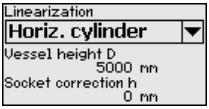


Fig. 30: Vessel height und socket correction value

D Vessel height
+h Positive socket correction value
-h Negative socket correction value

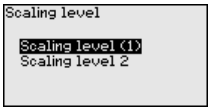






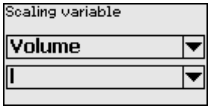
Setup - Scaling Level

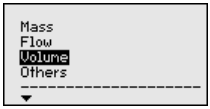
Since scaling is very extensive, scaling of the level value was divided into two menu items.



Setup - Scaling Level 1

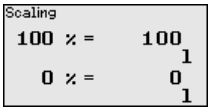
In menu item "*Level 1*" you define the scaling variable and the scaling unit for the level value on the display, e.g. volume in l.



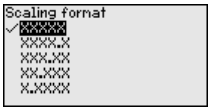


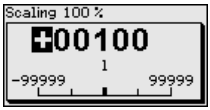
Setup - Scaling Level 2

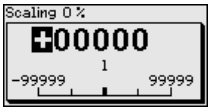
Since scaling is very extensive, scaling of the level value was divided into two menu items.



In menu item "*Level 2*" you define the scaling format on the display and the scaling of the measured level value for 0 % and 100 %.







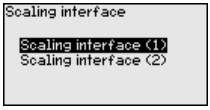
Setup - Scaling Interface

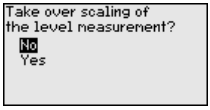
Since scaling is very extensive, scaling of the interface value was divided into two menu items.

Setup - Scaling Interface (1)

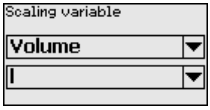
In menu item "*Interface 1*" you define the scaling size and the scaling unit for the interface value on the display, e.g. volume in l.

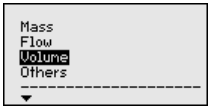
You can accept the scaling of the level measurement also for the interface measurement. If you select "*Yes*", the current setting is displayed.





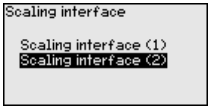
If you have selected "*No*", you can enter the scaling for the interface separately.

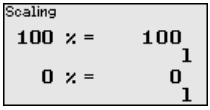


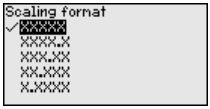


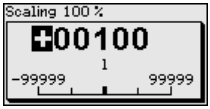
Setup - Scaling Interface (2)

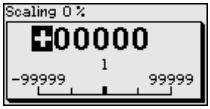
In menu item "*Interface (2)*" you define the scaling format on the display and the scaling of the interface measured value for 0 % and 100 %.





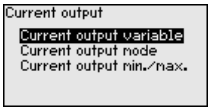


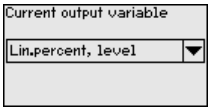


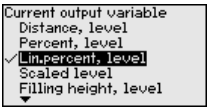


Setup - Current output Size

In menu item"*Current output, size*" you determine which measured value the current output refers to.

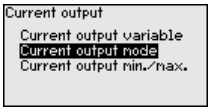


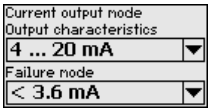


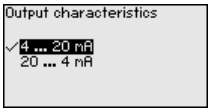


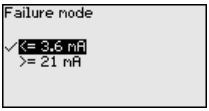
Setup - Current output mode

In the menu item "*Current output mode*" you determine the output characteristics and reaction of the current output in case of failure.





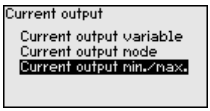


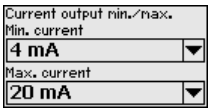


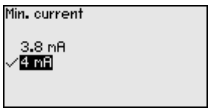
The default setting is output characteristics 4 … 20 mA, failure mode < 3.6 mA.

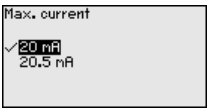
Setup - Current output Min./Max.

In the menu item "*Current output Min./Max.*", you determine the reaction of the current output during operation.









The default setting is min. current 3.8 mA and max. current 20.5 mA.

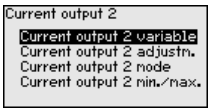
Setup - Current output 2

If a supplementary electronics with an additional current output is implemented in the instrument, then you can adjust the additional current output separately.

In menu item"*Current output 2*" you specify which measured value the additional current output refers to.

SIL The additional current output cannot be used as an output in the sense of a safety-instrumented application (SIL).

The procedure corresponds to the previous settings of the standard current output. See "*Setup - Current output*".



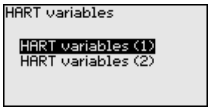
Setup - HART variables (1)

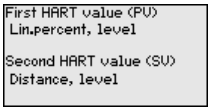
Since the HART variables are very extensive, the indication was divided into two menu items.

In the menu "*HART variables 1*" you can have the first HART value PV (primary value) and the second HART value SV (secondary value) of the sensor displayed.

The values cannot be changed in the display and adjustment module. To change these values, you have to use the adjustment software PACTware.

SIL HART functions are not relevant for SIL applications.



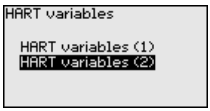


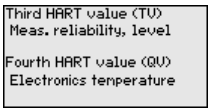
Setup - HART variables (2)

In the menu "*HART variables 2*" you can have the third HART value TV (third value) and the fourth HART value QV (quarter value) of the sensor displayed.

The values cannot be changed in the display and adjustment module. To change these values, you have to use the adjustment software PACTware.

SIL HART functions are not relevant for SIL applications.





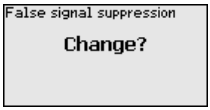
Setup - False signal suppression

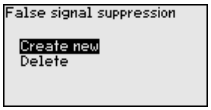
The following circumstances cause interfering reflections and can influence the measurement:

- High sockets
- Vessel installations such as struts

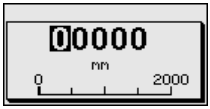
Note:
A false signal suppression detects, marks and saves these false signals so that they are no longer taken into account for the level and interface measurement. We generally recommend carrying out a false signal suppression to achieve the best possible accuracy. This should be done with the lowest possible level so that all potential interfering reflections can be detected.

Proceed as follows:





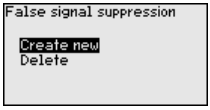
Enter the actual distance from the sensor to the product surface.



All interfering signals in this section are detected by the sensor and stored.

Note:
Check the distance to the product surface, because if an incorrect (too large) value is entered, the existing level will be saved as a false echo. The filling level would then no longer be detectable in this area.

If a false signal suppression has already been created in the sensor, the following menu window appears when selecting "*False signal suppression*":



The instrument carries out an automatic false signal suppression as soon as the probe is uncovered. The false signal suppression is always updated.

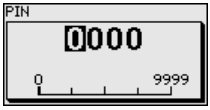
The menu item "*Delete*" is used to completely delete an already created false signal suppression. This is useful if the saved false signal suppression no longer matches the metrological conditions in the vessel.

Release setup - adjustment

With this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.

To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.

For this reason, the instrument is shipped in locked conditon. The PIN in the delivery status is "0000".

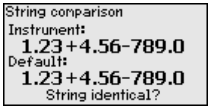


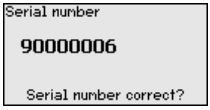
Character string comparison and serial number

You first have to carry out the character string comparison. This is used to check the character respresentation.

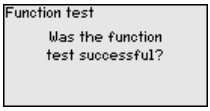
Confirm if the two character strings are identical. The verification texts are provided in German and with all other menu languages in English.

Afterwards you confirm that the serial number of your instrument was carried over correctly. This is used to check device communication.





In the next step, the instrument checks the data of the measurement and decides by means of the evaluation results if a functions test is required. If a function test is necessary, the following message is displayed.



In this case, you have to carry out a function test.

Function test

During a function test, you have to test the safety function of the instrument in the vessel with the original medium.

SIL You can find the detailed sequence of the function test in chapter "*Functional safety (SIL)*"

For this purpose, you should know the filling height of the vessel as well as the min. and max. levels respectively for 4 and 20 mA. You then can calculate the respective output current.

Measure the output current of VEGAFLEX 86 with a suitable multimeter and compare the measured output current with the calculated output current.

You have to determine the permissible deviation of the values yourself. This deviation depends on the the accuracy requirements of your measurement loop. Determine the permissible tolerance for the deviation.

SIL If you have to interrupt the function, you can leave the VEGAFLEX 86 in the respective situation.

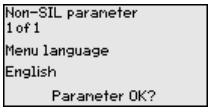
As long as VEGAFLEX 86 is powered, the display and adjustment module remains in the currently set adjustment menu.

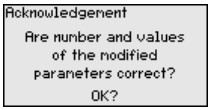
To interrupt the function test, you have to push the button "*ESC*".

If you carry out the function test by means of the "*PACTware*" software, you can store the previously performed tests and continue from there later on.

Verify parameter

All safety-relevant parameters must be verified after a change. After the function test, all modified, safety-relevant parameters will be listed. Confirm the modified values one after the other.





If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.

Otherwise the instrument remains in the released and hence unsafe condition.

SIL If you have to interrupt the function test, you can leave the display and adjustment module of VEGAFLEX 86 in its current state.

As long as VEGAFLEX 86 is powered, the display and adjustment module remains in the currently set adjustment menu.

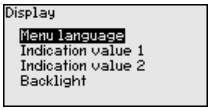
To interrupt the function test, you have to push the button "*ESC*".

If you carry out the function test by means of the "*PACTware*" software, you can store the previously performed tests and continue from there later on.

Display

In the main menu point "*Display*", the individual submenu points should be selected subsequently and provided with the correct parameters to ensure the optimum adjustment of the display options. The procedure is described in the following.

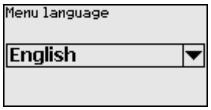
The following submenu points are available:

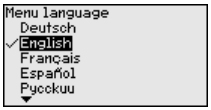


The submenu points described below.

Display - Menu language

This menu item enables the setting of the requested national language.

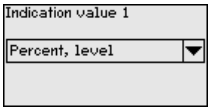


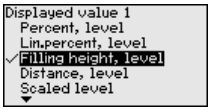


In the delivery status, the sensor is set to the ordered national language.

Display - Displayed value 1

In this menu item, you define the indication of the measured value on the display. You can display two different measured values. In this menu item, you define measured value 1.

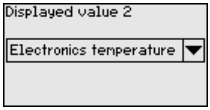


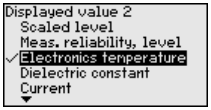


The default setting for the displayed value 1 is "*Filling height Level*".

Display - Displayed value 2

In this menu item, you define the indication of the measured value on the display. You can display two different measured values. In this menu item, you define measured value 2.





The default setting for the displayed value 2 is the electronics temperature.

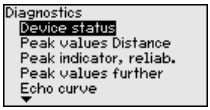
Display - Backlight

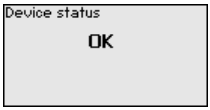
The optionally integrated background lighting can be adjusted via the adjustment menu. The function depends on the height of the supply voltage, see "*Technical data*".

The lighting is switched off in delivery status.

Diagnostics - Device status

In this menu item, the device status is displayed.

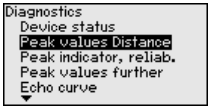


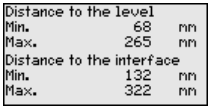


Diagnostics - Peak values Distance

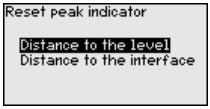
The respective min. and max. measured value is saved in the sensor. The two values are displayed in the menu item "*Peak values, distance*".

If you have selected interface measurement under the menu item "*Setup - Application*", the peak values of the interface measurement are displayed in addition to the peak values of the level measurement.





In another window you can carry out a reset of the two peak values separately.

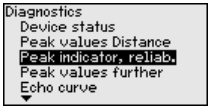


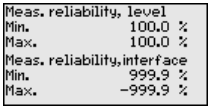
Diagnostics - Peak values Measurement certainty

The respective min. and max. measured values are saved in the sensor. The two values are displayed in the menu item "*Peak values, measurement certainty*".

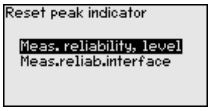
The measurement can be influenced by the process conditions. In this menu item, the measurement certainty of the level measurement is displayed as percentage value. The higher the value, the more reliable the measurement. Values > 90 % indicate reliable measurement.

If you have selected interface measurement under the menu item "*Setup - Application*", the peak values of the interface measurement are displayed in addition to the peak values of the level measurement.





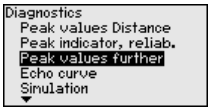
In another window you can carry out a reset of the two peak values separately.

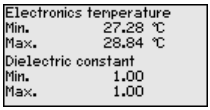


Diagnostics - Peak values Additional

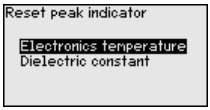
The respective min. and max. measured values are saved in the sensor. The values are displayed in the menu item "*Peak values Additional*".

This menu item displays the peak values of the electronics temperature as well as the dielectric constant.



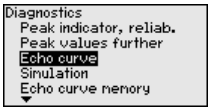


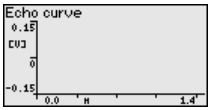
In another window you can carry out a reset of the two peak values separately.



Diagnostics - Echo curve

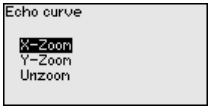
The menu item "*Echo curve*" shows the signal strength of the echoes over the measuring range in V. The signal strength enables an evaluation of the quality of the measurement.

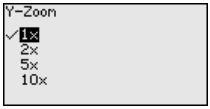




With the following functions you can zoom part sections of the echo curve.

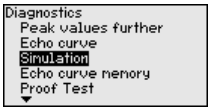
- "X-Zoom": Zoom function for the meas. distance
- "Y-Zoom": 1, 2, 5 and 10x signal magnification in "*V*"
- "Unzoom": Reset the presentation to the nominal measuring range with single magnification

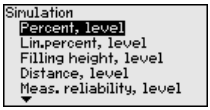




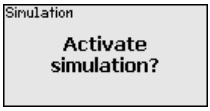
Diagnosis - Simulation

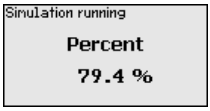
In this menu item you can simulate measured values via the current output. This allows the signal path to be tested, e.g. through downstream indicating instruments or the input card of the control system.

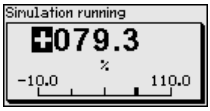




Select the requested simulation size and adjust the requested value.







Caution:
During simulation, the simulated value is outputted as 4 … 20 mA current value and digital HART signal.

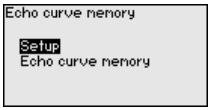
Push the ***[ESC]*** key to deactivate the simulation.

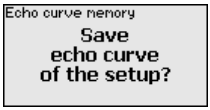
Information:
The simulation is terminated automatically 60 minutes after the last key has been pressed.

Diagnostics - Echo curve memory

With the menu item "*Setup*" the echo curve it is possible to save at the time of setup. This is generally recommended; for using the Asset Management functions it is necessary. If possible, the curve should be saved with a low level in the vessel.

With this, you can detect signal changes over the operating time. With the adjustment software PACTware and the PC, the high-resolution echo curve can be displayed and used to compare the echo curve of the setup with the actual echo curve.



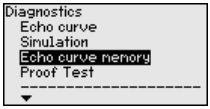


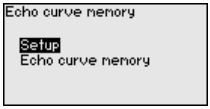
The function "*Echo curve memory*" enables storing echo curves of the measurement.

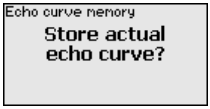
Under the sub-menu item "*Echo curve memory*" you can store the current echo curve.

Parameter settings for recording the echo curve and the settings of the echo curve itself can be carried out in the adjustment software PACTware.

With the adjustment software PACTware and the PC the high-resolution echo curve can be displayed and used later on to assess the quality of the measurement.

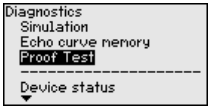


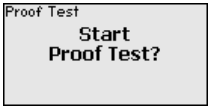


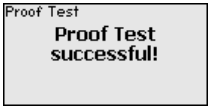


Diagnosis - Proof test

With the function "*Proof test*", the function of the instrument can be checked on a recurring basis.







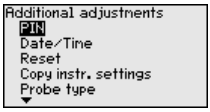
SIL

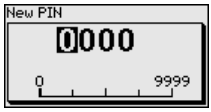
During the function test, the safety function must be treated as unsafe. Keep in mind that the function test influences downstream connected devices.

You can find detailed information on the proof test in the Safety Manual (SIL).

Additional settings - PIN

Entering a 4-digit PIN protects the sensor data against unauthorized access and unintentional modification. In this menu item, the PIN is displayed or edited and changed. However, this menu item is only available if adjustment is enabled in the menu "*Lock/Release setup/adjustment*".

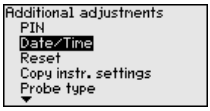


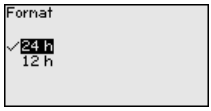


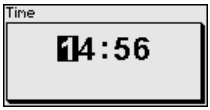
In delivery status, the PIN is "*0000*".

Additional adjustments - Date Time

In this menu item, the internal clock of the sensor is adjusted.

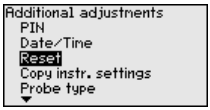






Additional adjustments - Reset

With a reset, certain parameter adjustments carried out by the user are reset.



The following reset functions are available:

Delivery status: Restoring the parameter settings at the time of shipment from the factory incl. the order-specific settings. A created false signal suppression, user-programmable linearization curve as well as the measured value memory will be deleted.

Basic settings: Resetting of the parameter settings incl. special parameters to the default values (presettings) of the respective instrument. Any created false signal suppression or user-programmable linearization curve as well as the measured value memory are deleted.

The following tables show the default values of the instrument. Depending on the instrument version or application, all menu items may not be available or some may be differently assigned.

The menu items in bold are safety-relevant in terms of the functional safety according to IEC 61508 (Edition 2) SIL.

Setup

Menu item	Default value	Modified value
Lock adjustment	Locked	
Measurement loop name	Sensor	
Units	Distance unit: mm Temperature unit: °C	
Probe length	Length of the probe Ex factory	
Type of medium	Liquid	
Application	Level, vessel	
Medium, dielectric constant	Water-based, > 10	
Superimposed gas phase	Yes	
Dielectric constant, upper medium (TS)	1.5	
Tube inner diameter	200 mm	
Max. adjustment - Level	100 %	
Max. adjustment - Level	Distance: 0.000 m(d) - note blocking distances	
Min. adjustment - Level	0 %	
Min. adjustment - Level	Distance: Probe length - take dead band into account	
Accept adjustment of the level measurement?	Yes	
Max. adjustment - Interface	100 %	
Max. adjustment - Interface	Distance: 0.000 m(d) - note blocking distances	
Min. adjustment - Interface	0 %	
Min. adjustment - Interface	Distance: Probe length - take dead band into account	
Integration time - Level	0.0 s	
Integration time - Interface	0.0 s	
Linearization type	Linear	
Linearization - Socket correction	0 mm	
Linearization - Vessel height	Probe length	
Scaling size - Level	Volume in l	
Scaling unit - Level	Litres	
Scaling format - Level	Without decimal positions	
Scaling level - 100 % correspond to	100	
Scaling level - 0 % correspond to	0	
Accept scaling of the level measurement	Yes	
Scaling variable - Interface	Volume	
Scaling unit - Interface	Litres	
Scaling format - Interface	Without decimal positions	

Menu item	Default value	Modified value
Scaling interface - 100 % correspond to	100	
Scaling interface - 0 % correspond to	0	
Current output, output variable First HART variable (PV)	Lin. percent - Level	
Current output - Output characteristics	0 … 100 % correspond to 4 … 20 mA	
Current output - Reaction in case of failure	≤ 3.6 mA	
Current output - Min.	3.8 mA	
Current output - Max.	20.5 mA	
Current output 2 - Output variable Second HART variable (SV)	Distance - Level	
Current output 2 - Output characteristics	0 … 100 % correspond to 4 … 20 mA	
Current output 2 - Reaction in case of failure	≤ 3.6 mA	
Current output - Min.	3.8 mA	
Current output - Max.	20.5 mA	
Third HART variable (TV)	Measurement certainty, level	
Fourth HART variable (QV)	Electronics temperature	

Display

Menu item	Default value	Modified value
Language	Order-specific	
Displayed value 1	Filling height Level	
Displayed value 2	Electronics temperature	
Backlight	Switched off	

Diagnostics

Menu item	Default value	Modified value
Status signals - Function control	Switched on	
Status signals - Out of specification	Switched off	
Status signals - Maintenance	Switched on	
Device memory - Echo curve memory	Stopped	
Device memory - Measured value memory	Started	
Device memory - Measured value memory - Measured values	Distance level, percentage value level, reliability level, electronics temperature	
Device memory - Measured value memory - Recording in time interval	3 min.	
Device memory - Measured value memory - Recording with measured value difference	15 %	

Menu item	Default value	Modified value
Device memory - Measured value memory - Start with measured value	Not active	
Device memory - Measured value memory - Stop with measured value	Not active	
Device memory - Measured value memory - Stop recording when memory is full	Not active	

Additional adjustments

Menu item	Default value	Modified value
PIN	0000	
Date	Actual date	
Time	Actual time	
Time - Format	24 hours	
Probe type	Device-specific	
HART mode	Analogue current output	

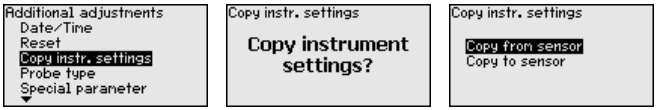
Additional adjustments - Copy instrument settings

The instrument settings are copied with this function. The following functions are available:

- Read from sensor: Read data from sensor and store into the display and adjustment module
- Write into sensor: Store data from the display and adjustment module back to the sensor

The following data or settings for adjustment of the display and adjustment module are saved:

- All data of the menu "*Setup*" and "*Display*"
- In the menu "*Additional adjustments*" the items "*Reset, Date/Time*"
- Special parameters

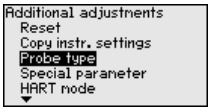


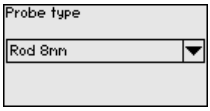
The copied data are permanently saved in an EEPROM memory in the display and adjustment module and remain there even in case of power failure. From there, they can be written into one or more sensors or kept as backup for a possible electronics exchange.

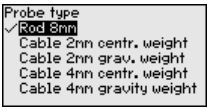
Note:
Before the data are stored in the sensor, a check is carried out to determine if the data fit the sensor. If the data do not fit, a fault signal is triggered or the function is blocked. When data are being written into the sensor, the display shows which instrument type the data originate from and which TAG-no. this sensor had.

Additional adjustments - Probe type

In this menu item you can select the type and size of your probe from a list of all possible probes. This is necessary to adapt the electronics optimally to the probe.



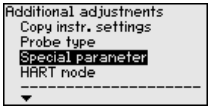




Additional adjustments - Special parameters

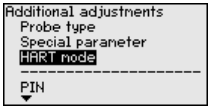
In this menu item you gain access to the protected area where you can enter special parameters. In exceptional cases, individual parameters can be modified in order to adapt the sensor to special requirements.

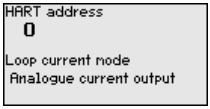
Change the settings of the special parameters only after having contacted our service staff.

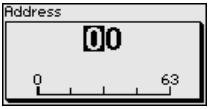


Additional adjustments - HART mode

The sensor is fix adjusted to the HART mode "*Analogue current output*". This parameter cannot be modified.







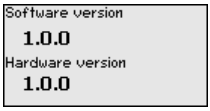
The default setting is "*Analogue current output*" and the address 00.

Info - Instrument name

In this menu, you read out the instrument name and the instrument serial number.

Info - Instrument version

In this menu item, the hardware and software version of the sensor is displayed.



Info - Factory calibration date

In this menu item, the date of factory calibration of the sensor as well as the date of the last change of sensor parameters are displayed via the display and adjustment module or via the PC.

Info - Sensor characteristics

In this menu item, the features of the sensor such as approval, process fitting, seal, measuring range, electronics, housing and others are displayed.

44234-EN-140430

7.4 Saving the parameter adjustment data

We recommended noting the adjusted data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

If the instrument is equipped with a display and adjustment module, the data in the sensor can be saved in the display and adjustment module. The procedure is described in the operating instructions manual "*Display and adjustment module*" in the menu item "*Copy sensor data*". The data remain there permanently even if the sensor power supply fails.

The following data or settings for adjustment of the display and adjustment module are saved:

- All data of the menu "*Setup*" and "*Display*"
- In the menu "*Additional adjustments*" the items "*Sensor-specific units, temperature unit and linearization*"
- The values of the user programmable linearization curve

The function can also be used to transfer settings from one instrument to another instrument of the same type. If it is necessary to exchange a sensor, the display and adjustment module is inserted into the replacement instrument and the data are likewise written into the sensor via the menu item "*Copy sensor data*".

8 Setup with PACTware

8.1 Connect the PC

Via the interface adapter directly on the sensor

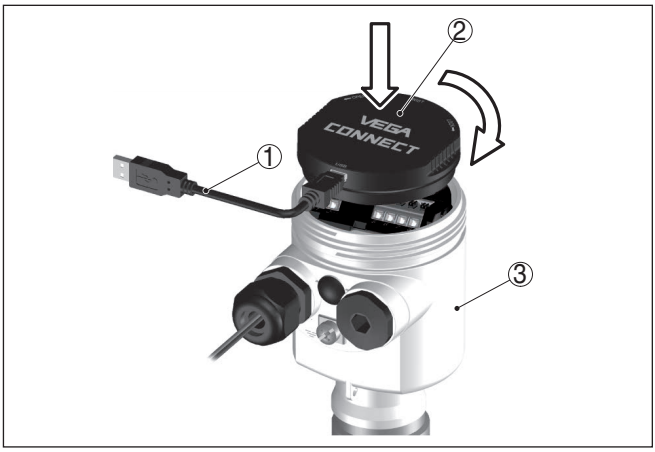


Fig. 31: Connection of the PC directly to the sensor via the interface adapter

1 USB cable to the PC
2 Interface adapter VEGACONNECT
3 Sensor

Via the interface adapter and HART

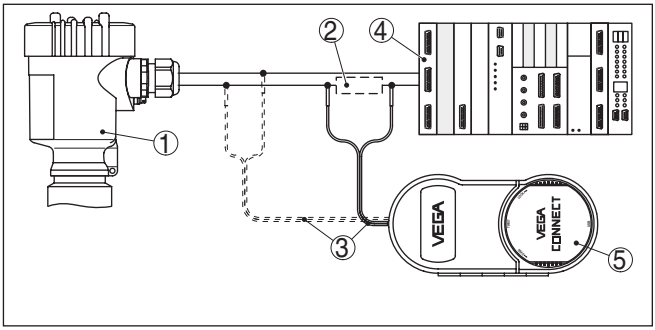


Fig. 32: Connecting the PC via HART to the signal cable

1 Sensor
2 HART resistance 250 Ω (optional depending on processing)
3 Connection cable with 2 mm pins and terminals
4 Processing system/PLC/Voltage supply
5 Interface adapter, for example VEGACONNECT 4

Note:
With power supply units with integrated HART resistance (internal resistance approx. 250 Ω), an additional external resistance is not necessary. This applies, e.g. to the VEGA instruments VEGATRENN 149A, VEGAMET 381, VEGAMET 391. Common Ex separators are also usually equipped with a sufficient current limitation resistance. In

such cases, the interface converter can be connected parallel to the 4 … 20 mA cable (dashed line in the previous illustration).

8.2 Parameter adjustment with PACTware

Prerequisites

For parameter adjustment of the sensor via a Windows PC, the configuration software PACTware and a suitable instrument driver (DTM) according to FDT standard are required. The up-to-date PACTware version as well as all available DTMs are compiled in a DTM Collection. The DTMs can also be integrated into other frame applications according to FDT standard.

Note:

To ensure that all instrument functions are supported, you should always use the latest DTM Collection. Furthermore, not all described functions are included in older firmware versions. You can download the latest instrument software from our homepage. A description of the update procedure is also available in the Internet.

Further setup steps are described in the operating instructions manual "*DTM Collection/PACTware*" attached to each DTM Collection and which can also be downloaded from the Internet. Detailed descriptions are available in the online help of PACTware and the DTMs.

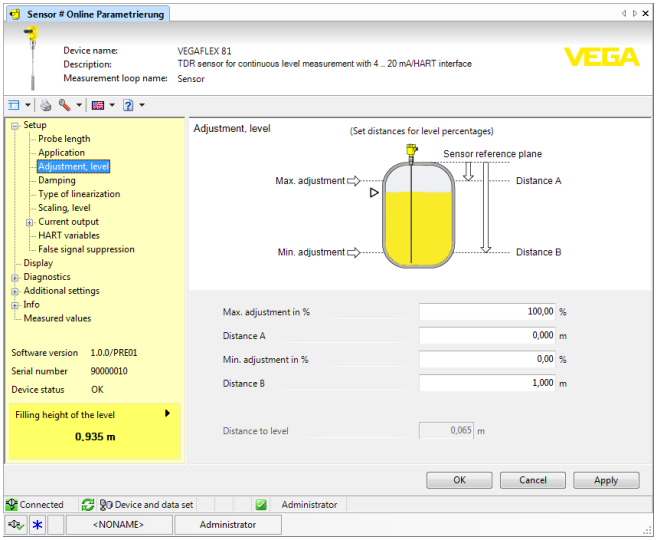


Fig. 33: Example of a DTM view

Standard/Full version

All device DTMs are available as a free-of-charge standard version and as a full version that must be purchased. In the standard version, all functions for complete setup are already included. An assistant for simple project configuration simplifies the adjustment considerably. Saving/printing the project as well as import/export functions are also part of the standard version.

In the full version there is also an extended print function for complete project documentation as well as a save function for measured value and echo curves. In addition, there is a tank calculation program as well as a multiviewer for display and analysis of the saved measured value and echo curves.

The standard version is available as a download under www.vega.com/downloads and "*Software*". The full version is available on CD from the agency serving you.

8.3 Saving the parameter adjustment data

We recommend documenting or saving the parameter adjustment data via PACTware. That way the data are available for multiple use or service purposes.

9 Set up with other systems

9.1 DD adjustment programs

Device descriptions as Enhanced Device Description (EDD) are available for DD adjustment programs such as, for example, AMS™ and PDM.

The files can be downloaded at www.vega.com/downloads under "*Software*".

9.2 Field Communicator 375, 475

Device descriptions for the instrument are available as EDD for parameter adjustment with the Field Communicator 375 or 475.

For the integration of the EDD in the Field Communicator 375 or 475, the software "Easy Upgrade Utility" is required which is available from the manufacturer. This software is updated via the Internet and new EDDs are automatically taken over into the device catalogue of this software after they are released by the manufacturer. They can then be transferred to a Field Communicator.

10 Diagnostics and service

10.1 Maintenance

If the device is used correctly, no maintenance is required in normal operation.

When used in safety-instrumented systems (SIS), the safety function must be carried out on the instrument in regular time intervals by means of a proof test.

Hence possible undetected, dangerous failure can be identified.

The operator's responsibility to select the kind of test. The time intervals depend on the used PFD_{AVG}.

SIL During the function test, the safety function must be treated as unsafe. Keep in mind that the function test influences downstream connected devices.

If one of the tests proves negative, the entire measuring system must be switched out of service and the process held in a safe state by means of other measures.

You can find detailed information on the proof test in the Safety Manual (SIL).

10.2 Diagnosis memory

The instrument has several memories which are available for diagnosis purposes. The data remain even with voltage interruption.

Measured value memory

Up to 100,000 measured values can be stored in the sensor in a ring memory. Each entry contains date/time as well as the respective measured value. Storable values are for example:

- Distance
- Filling height
- Percentage value
- Lin. percent
- Scaled
- Current value
- Meas. reliability
- Electronics temperature

When the instrument is shipped, the measured value memory is active and stores distance, measurement certainty and electronics temperature every 3 minutes.

In "Extended adjustment" you can select the respective measured values.

The requested values and recording conditions are set via a PC with PACTware/DTM or the control system with EDD. Data are thus read out and also reset.

Event memory

Up to 500 events are automatically stored with a time stamp in the sensor (non-deletable). Each entry contains date/time, event type, event description and value. Event types are for example:

- Modification of a parameter

- Switch-on and switch-off times
- Status messages (according to NE 107)
- Error messages (according to NE 107)

The data are read out via a PC with PACTware/DTM or the control system with EDD.

Echo curve memory

The echo curves are stored with date and time and the corresponding echo data. The memory is divided into two sections:

Echo curve of the setup: This is used as reference echo curve for the measurement conditions during setup. Changes in the measurement conditions during operation or buildup on the sensor can thus be recognized. The echo curve of the setup is stored via:

- PC with PACTware/DTM
- Control system with EDD
- Display and adjustment module

Further echo curves: Up to 10 echo curves can be stored in a ring buffer in this memory section. Further echo curves are stored via:

- PC with PACTware/DTM
- Control system with EDD
- Display and adjustment module

10.3 Status messages

The instrument features self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650. In addition to the status messages in the following tables there are more detailed error messages available under the menu item "*Diagnostics*" via the display and adjustment module, PACTware/DTM and EDD.

Status messages

The status messages are divided into the following categories:

- Failure
- Function check
- Out of specification
- Maintenance requirement

and explained by pictographs:

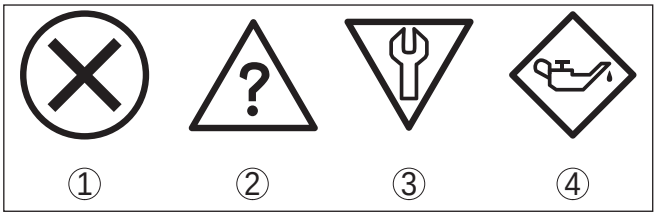


Fig. 34: Pictographs of the status messages

1 Failure - red
2 Out of specification - yellow
3 Function check - orange
4 Maintenance - blue

Failure: Due to a malfunction in the instrument, a failure message is outputted.

This status message is always active. It cannot be deactivated by the user.

Function check: The instrument is in operation, the measured value is temporarily invalid (for example during simulation).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Out of specification: The measured value is unstable because the instrument specification is exceeded (e.g. electronics temperature).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Maintenance: Due to external influences, the instrument function is limited. The measurement is affected, but the measured value is still valid. Plan in maintenance for the instrument because a failure is expected in the near future (e.g. due to buildup).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Failure

The following table shows the error codes in the status message "*Failure*" and gives information on the reason and rectification. Keep in mind that some information is only valid with four-wire instruments.

Code Text message	Cause	Rectification
F013 no measured value available	– Sensor does not detect an echo during operation – Process component or probe contaminated or defective	– Check or correct installation and/or parameter adjustment – Clean or exchange process component or probe
F017 Adjustment span too small	– Adjustment not within specification	– Change adjustment according to the limit values (difference between min. and max. ≥ 10 mm)
F025 Error in the linearization table	– Index markers are not continuously rising, for example illogical value pairs	– Check values of the linearization table – Delete/create a new linearization table
F036 No operable software	– Failed or interrupted software update	– Repeat software update – Check electronics version – Exchanging the electronics – Send instrument for repair
F040 Error in the electronics	– Hardware defect	– Exchanging the electronics – Send instrument for repair
F041 Probe loss	– Cable probe broken or rod probe defective	– Check probe and exchange, if necessary

44234-EN-140430

Code Text message	Cause	Rectification
F080 General software error	– General software error	– Disconnect operating voltage briefly
F105 Measured value is determined	– The instrument is still in the start phase, the measured value could not yet be determined	– Wait for the end of the switch-on phase – Duration depending on the version and parameter adjustment max. 5 min.
F113 Communication error	– EMC interference – Transmission error with the external communication with 4-wire power supply unit	– Remove EMC influences – Exchange 4-wire power supply unit or electronics
F125 Impermissible electronics temperature	– Temperature of the electronics in the non-specified section	– Check ambient temperature – Isolate electronics – Use instrument with higher temperature range
F260 Error in the calibration	– Error in the calibration carried out in the factory – Error in the EEPROM	– Exchanging the electronics – Send instrument for repair
F261 Error in the instrument settings	– Error during setup – Error when carrying out a reset – False signal suppression faulty	– Carry out a reset – Repeat setup
F264 Installation/ Setup error	– Error during setup	– Check or correct installation and/or parameter adjustment – Check probe length
F265 Measurement function disturbed	– Sensor no longer carries out a measurement	– Carry out a reset – Disconnect operating voltage briefly
F266 Impermissible operating voltage	– Operating voltage below specified range	– Check electrical connection – if necessary, increase operating voltage
F267 No executable sensor software	– Sensor cannot start	– Exchanging the electronics – Send instrument for repair

Function check

The following table shows the error codes and text messages in the status message "*Function check*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification
C700 Simulation active	– A simulation is active	– Finish simulation – Wait for the automatic end after 60 mins.
C701 Parameter verification	– Parameter verification was interrupted	– Finish parameter verification

Out of specification

The following table shows the error codes and text messages in the status message "*Out of specification*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification
S600 Impermissible electronics temperature	– Temperature of the electronics in the non-specified section	– Check ambient temperature – Isolate electronics – Use instrument with higher temperature range
S601 Overfilling	– Danger of vessel overfilling	– Make sure that there is no further filling – Check level in the vessel
S603 Impermissible operating voltage	– Operating voltage below specified range	– Check electrical connection – if necessary, increase operating voltage

Maintenance

The following table shows the error codes and text messages in the status message "*Maintenance*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification
M500 Error with the reset delivery status	– With the reset to delivery status, the data could not be restored	– Repeat reset – Load XML file with sensor data into the sensor
M501 Error in the non-active linearization table	– Hardware error EEPROM	– Exchanging the electronics – Send instrument for repair
M502 Error in the diagnosis memory	– Hardware error EEPROM	– Exchanging the electronics – Send instrument for repair

44234-EN-140430

Code Text message	Cause	Rectification
M503 Reliability too low	– The echot/noise ratio is the small for a reliable measurement	– Check installation and process conditions – Clean the antenna – Change polarisation direction – Use instrument with higher sensitivity
M504 Error on an device interface	– Hardware defect	– Check connections – Exchanging the electronics – Send instrument for repair
M505 No echo available	– Level echo can no longer be detected	– Clean the antenna – Use a more suitable antenna/sensor – Remove possible false echoes – Optimize sensor position and orientation

10.4 Rectify faults

Reaction when malfunctions occur

The operator of the system is responsible for taking suitable measures to rectify faults.

Procedure for fault rectification

The first measures are:

- Evaluation of fault messages, for example via the display and adjustment module
- Checking the output signal
- Treatment of measurement errors

Further comprehensive diagnostics options are available with a PC with PACTware and the suitable DTM. In many cases, the reasons can be determined in this way and faults rectified.

Check the 4 … 20 mA signal

Connect a multimeter in the suitable measuring range according to the wiring plan. The following table describes possible errors in the current signal and helps to remove them:

Error	Cause	Rectification
4 … 20 mA signal not stable	– Fluctuations of the measured variable	– Set damping according to the instrument via the display and adjustment module or PACTware/DTM

Error	Cause	Rectification
4 … 20 mA signal missing	– Electrical connection faulty	– Check connection according to chapter "*Connection steps*" and if necessary, correct according to chapter "*Wiring plan*"
	– Voltage supply missing	– Check cables for breaks; repair if necessary
	– Operating voltage too low or load resistance too high	– Check, adapt if necessary
Current signal greater than 22 mA or less than 3.6 mA	– Electronics module in the sensor defective	– Exchange the instrument or send it in for repair

Treatment of measurement errors

The below tables show typical examples for application-relevant measurement errors. There are two measurement errors:

- Constant level
- Filling
- Emptying

The images in column "*Error pattern*" show the real level with a broken line and the level displayed by the sensor as a continuous line.

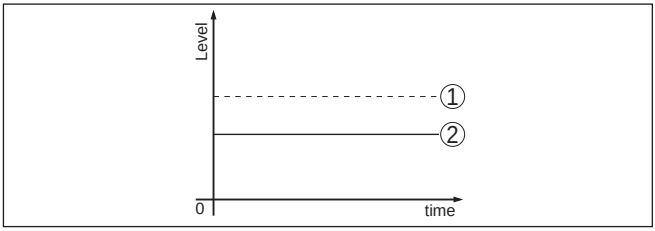
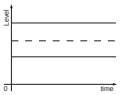
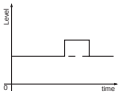


Fig. 35: The broken line 1 shows the real level, the continuous line 2 shows the level displayed by the sensor

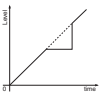
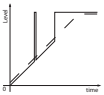
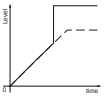
Note:

- Wherever the sensor displays a constant value, the reason could also be the fault setting of the current output to "*Hold value*"
- In case of a too low level indication, the reason could be a line resistance that is too high

Measurement error with constant level

Fault description	Error pattern	Cause	Rectification
1. Measured value shows a too low or too high level		– Min./max. adjustment not correct	– Adapt min./max. adjustment
		– Wrong linearization curve	– Adapt linearization curve
		– Running time error (small measurement error close to 100 %/serious error close to 0 %)	– Repeat setup
2. Measured value jumps towards 100 %		– Due to the process, the amplitude of the product echo sinks – A false signal suppression was not carried out	– Carry out a false signal suppression
		– Amplitude or position of a false signal has changed (e.g. buildup); false signal suppression no longer matches	– Determine the reason for the changed false signals, carry out false signal suppression, e.g. with buildup

Measurement error during filling

Fault description	Error pattern	Cause	Rectification
3. Measured value remains in the area of the bottom during filling		– Echo from the probe end larger than the product echo, for example, with products with ε_r < 2.5 oil-based, solvents, etc.	– Check parameter "Medium" and "Vessel height", adapt if necessary
4. Measured value remains momentarily unchanged during filling and then jumps to the correct level		– Turbulence on the product surface, quick filling	– Check parameters, change if necessary, e.g. in dosing vessel, reactor
5. Measured value jumps sporadically to 100 % during filling		– Changing condensation or contamination on the probe	– Carry out a false signal suppression
6. Measured value jumps to ≥ 100 % or 0 m distance		– Level echo is no longer detected in the close range due to false signals in the close range. The sensor goes into overfill protection mode. The max. level (0 m distance) as well as the status message "Overfill protection" are outputted.	– Eliminate false signals in the close range – Check installation conditions – If possible, switch off the function "Overfill protection"

Measurement error during emptying

Fault description	Error pattern	Cause	Rectification
7. Measured value remains unchanged in the close range during emptying		– False echo larger than the level echo – Level echo too small	– Eliminate false signals in the close range – Remove contamination on the probe. After having removed the source of the false signals, the false signal suppression must be deleted. – Carry out a new false signal suppression
8. Measured value remains reproducible in one position during emptying		– Stored false signals in this position are larger than the level echo	– Delete false signal memory – Carry out a new false signal suppression

Reaction after fault rectification

Depending on the reason for the fault and the measures taken, the steps described in chapter "*Setup*" must be carried out again or must be checked for plausibility and completeness.

24 hour service hotline

Should these measures not be successful, please call in urgent cases the VEGA service hotline under the phone no. **+49 1805 858550**.

The hotline is also available outside normal working hours, seven days a week around the clock.

Since we offer this service worldwide, the support is provided in English. The service itself is free of charge, the only costs involved are the normal call charges.

10.5 Exchanging the electronics module

If the electronics module is defective, it can be replaced by the user.

SIL With SIL qualified instrument, only a respective electronics module with SIL qualification must be used.

Ex In Ex applications, only instruments and electronics modules with appropriate Ex approval may be used.

Order the replacement electronics module through the agency serving you. The electronics modules are adapted to the respective sensor.

It is absolutely necessary that the factory settings of the sensor are loaded into the electronics module. Therefore please state the serial number of the sensor when ordering the replacement electronics module.

The serial numbers are stated on the type label of the instrument, inside the housing or on the delivery note.

The replacement electronics module is provided with the serial number of the appropriate sensor. Check if the serial number on the replacement electronics module and the serial number of the sensor correspond.

SIL All user-specific settings must be entered again. Hence, you have to carry out a new setup after the electronics exchange.

If you have stored the data of the parameter adjustment during the first setup of the sensor, you can transfer these to the replacement electronics module. A new setup is no more necessary.

After the new setup and the transfer of the parameterization date, you have to verify the parameters. Only then, the instrument will be ready for operation, again.

10.6 Exchange or shorten cable/rod

Exchanging the cable/rod

The cable or rod (meas. part) of the probe can be shortened, if necessary. To loosen the rod or cable you need a fork spanner with spanner width 13.

1. Loosen the rod or cable by applying a fork spanner to the flat surfaces (SW 13), provide counterforce with another fork spanner (SW 13)
2. Unscrew the loosened rod or cable manually.
3. Place the enclosed new double washer onto the thread.

Caution:
Make sure that the two components of the double washer remain together.

4. Screw the new rod and the new cable manually to the thread on the process fitting.
5. Exert counterforce with the second fork spanner and tighten the or or cable on the flat surfaces with a torque of 20 Nm (15 lbf ft).

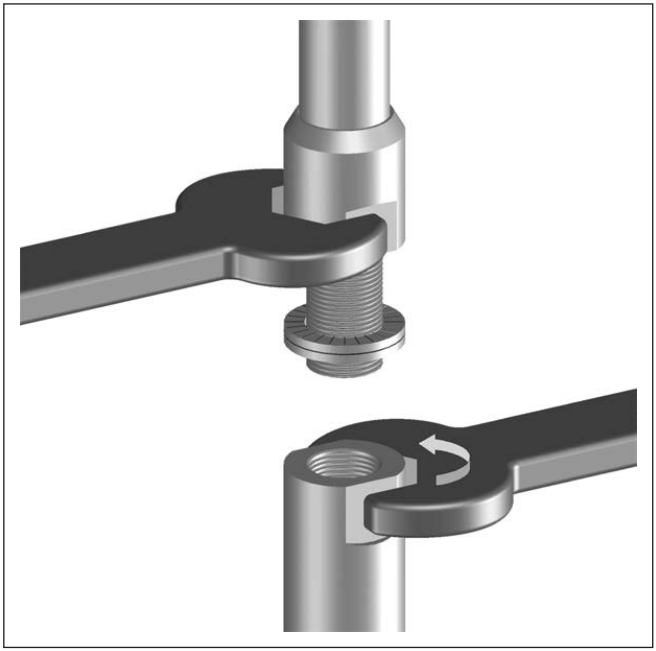


Fig. 44: Exchange cable or rod

Information:
Please maintain the specified torque so that the max. tensile strength remains.

6. Enter new probe length and if necessary the new probe type and then carry out a fresh adjustment (see "*Setup procedure, Carrying out min. adjustment - Carrying out max. adjustment*").

Shorten cable/rod

The rod or cable of the probe can be shortened individually.

1. Mark the requested length with mounted measuring rod.
2. Cable: Loosen the pins on the gravity weight (hexagon 3)
3. Cable: remove the pins
4. Cable: Pull the cable out of the gravity weight
5. Shorten the cable/rod with a cut-off wheel or metal saw at the marking. Take note of the specifications in the following illustration when shortening the cable.
6. Cable with gravity weight: Shift the cable according to the drawing into the gravity weight
7. Cable with gravity weight: Fasten cable with the pins, torque 7 Nm (5.16 lbf ft)

   Cable with centering weight: Fasten cable with the pins, torque 7 Nm (5.16 lbf ft) and fix the clamping part on the centering weight.
8. Enter new probe length and then carry out a fresh adjustment (see "*Setup procedure, Carrying out min. adjustment - Carrying out max. adjustment*").

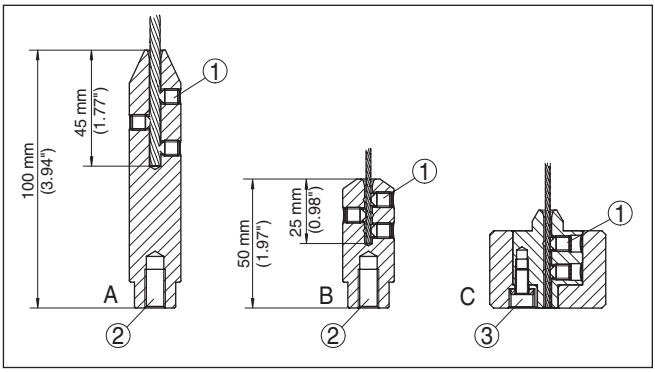


Fig. 45: Shortening the cable probe

A Gravity weight - cable ø 4 mm
B Gravity weight - cable ø 2 mm
C Centering weight - cable ø 2 mm
1 Threaded pins
2 Thread M8 for eye-bolt
3 Fixing screw - centering weight

10.7 Software update

The following components are required to update the sensor software:

- Sensor
- Voltage supply
- Interface adapter VEGACONNECT
- PC with PACTware
- Current sensor software as file

You can find the actual sensor software as well as detailed information of the procedure under "www.vega.com/downloads" and "*Software*".

You can find information about the installation in the download file.

SIL Make sure that you are using the correct software with SIL qualification.

Instruments with SIL qualification can only be updated with a respective software. An accidental update with a wrong software version is impossible.

Caution:
Instruments with approvals can be bound to certain software versions. Therefore make sure that the approval is still effective after a software update is carried out.

You can find detailed information at www.vega.com/downloads and "*Approvals*".

10.8 How to proceed if a repair is needed

You can find a repair form as well as detailed information on how to proceed at www.vega.com/downloads and "*Forms and certificates*".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

If a repair is necessary, please proceed as follows:

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and, if need be, also a safety data sheet outside on the packaging
- Please contact the agency serving you to get the address for the return shipment. You can find the agency on our home page www.vega.com.

11 Dismounting

11.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel or pipeline, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

11.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the parts to be easily separable.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

12 Supplement

12.1 Technical data

General data

316L corresponds to 1.4404 or 1.4435	
Materials, wetted parts	
– Process fitting - rod version	316L, Alloy C22 (2.4602) and Aluminium oxide-ceramic 99.7 % (Al_2O_3) or Alloy C22 (2.4602) and Aluminium oxide-ceramic 99.7 % (Al_2O_3)
– Process fitting - cable version	316L and Aluminium oxide-ceramic 99.7 % (Al_2O_3)
– Process seal on the instrument side (cable/rod leadthrough)	Aluminium oxide-ceramic 99.7 % (Al_2O_3) and graphite
– Rod: ø 16 mm (0.63 in)	316L or Alloy C22 (2.4602)
– Cable: ø 2 mm (0.079 in)	316 (1.4401)
– Cable: ø 4 mm (0.157 in)	316 (1.4401)
– Gravity weight (optionally available)	316L
– Centering weight (optionally available)	316L
– Process seal	On site
Materials, non-wetted parts	
– Plastic housing	plastic PBT (Polyester)
– Aluminium die-casting housing	Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
– Stainless steel housing - precision casting	316L
– Stainless steel housing, electropolished	316L
– Second line of defence	Borosilicate glass GPC 540
– Seal between housing and housing cover	NBR (stainless steel housing, precision casting), silicone (aluminium/plastic housing; stainless steel housing, electropolished)
– Inspection window in housing cover (optional)	Polycarbonate (with Ex d version: glass)
– Ground terminal	316L
Second line of defence	
– Supporting material	316L
– Glass potting	Borosilicate glass GPC 540
– Contacts	Alloy C22
– Helium leak rate	< 10^{-6} mbar l/s
– Pressure resistance	See process pressure of the sensor
Ohmic contact	Between ground terminal, process fitting and probe
Process fittings	
– Pipe thread, cylindrical (ISO 228 T1)	G1½ according to DIN 3852-A

– American pipe thread, conical (ASME B1.20.1)	1½ NPT
– Flanges	e.g. DIN from DN 50, ANSI from 2"
Weight	
– Instrument weight (depending on process fitting)	approx. 6 … 12 kg (13.23 … 26.46 lbs)
– Rod: ø 16 mm (0.63 in)	approx. 1580 g/m (17 oz/ft)
– Cable: ø 2 mm (0.079 in)	approx. 16 g/m (0.17 oz/ft)
– Cable: ø 4 mm (0.157 in)	approx. 60 g/m (0.65 oz/ft)
– Gravity weight for cable ø 2 mm (0.079 in)	100 g (3.22 oz)
– Gravity weight for cable ø 4 mm (0.157 in)	200 g (6.43 oz)
– Centering weight ø 40 mm (1.575 in)	180 g (5.79 oz)
– Centering weight ø 45 mm (1.772 in)	250 g (8.04 oz)
– Centering weight ø 75 mm (2.953 in)	825 g (26.52 oz)
– Centering weight (ø 95 mm (3.74 in)	1050 g (33.76 oz)
Probe length L (from seal surface)	
– Rod: ø 16 mm (0.63 in)	up to 6 m (19.69 ft)
– Trimming accuracy - rod	±(1 mm + 0.05 % of the rod length)
– Cable: ø 2 mm (0.079 in)	up to 75 m (246.1 ft)
– Cable: ø 4 mm (0.157 in)	up to 75 m (246.1 ft)
– Trimming accuracy - cable	±(2 mm + 0.05 % of the cable length)
Lateral load	
– Rod: ø 16 mm (0.63 in)	30 Nm (22 lbf ft)
Max. tensile load	
– Cable: ø 2 mm (0.079 in)	1.5 KN (337 lbf)
– Cable: ø 4 mm (0.157 in)	2.5 KN (562 lbf)
Thread in gravity weight, e.g. for eye-bolt (cable version)	M 8
Torque for process fitting, thread	
– -196 … +280 °C (-321 … +536 °F)	max. 450 Nm (332 lbf ft)
– -196 … +450 °C (-321 … +842 °F)	max. 400 Nm (295 lbf ft)
Torque for exchangeable cable or rod probe (in the process fitting)	
– Cable: ø 2 mm (0.079 in)	20 Nm (14.75 lbf ft)
– Cable: ø 4 mm (0.157 in)	20 Nm (14.75 lbf ft)
– Rod: ø 16 mm (0.63 in)	20 Nm (14.75 lbf ft)
Torque for NPT cable glands and Conduit tubes	
– Plastic housing	max. 10 Nm (7.376 lbf ft)
– Aluminium/Stainless steel housing	max. 50 Nm (36.88 lbf ft)

Input variable

Measured variable	Level of liquids
Min. dielectric constant of the medium	
– Cable probes	$\varepsilon_r \geq 1.6$
– Rod probes	$\varepsilon_r \geq 1.6$

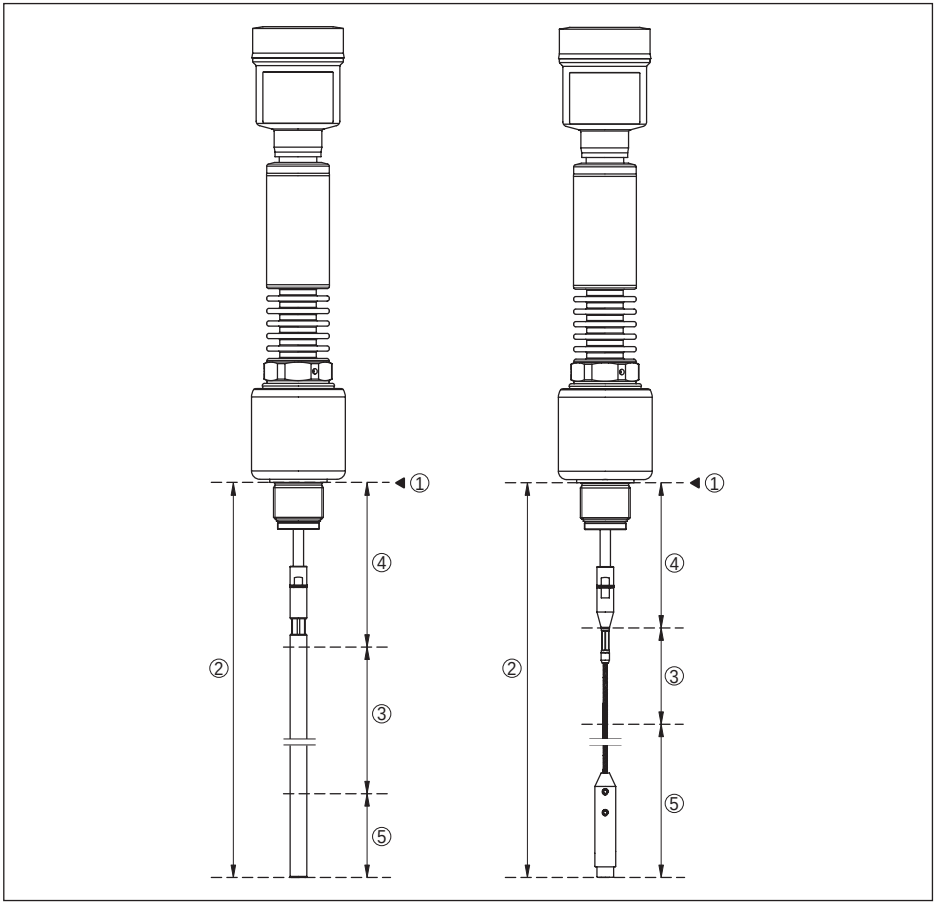


Fig. 46: Measuring ranges - VEGAFLEX 86

1 Reference plane
2 Probe length L
3 Measuring range (default setting refers to the measuring range in water)
4 Upper dead band (see diagrams under Accuracy - grey section)
5 Lower dead band (see diagrams under Accuracy - grey section)

Output variable

Output signal	4 … 20 mA/HART
Range of the output signal	3.8 … 20.5 mA/HART (default setting)

44234-EN-140430

Fulfilled HART specification	7
Signal resolution	0.3 µA
Failure signal current output (adjustable)	≥ 21 mA, ≤ 3.6 mA
Max. output current	21.5 mA
Starting current	≤ 10 mA for 5 ms after switching on, ≤ 3.6 mA
Load	see load diagram under Power supply
Damping (63 % of the input variable), adjustable	0 … 999 s
HART output values according to HART 7 (default setting)[1]	
– First HART value (PV)	Linearised percentage value, level
– Second HART value (SV)	Distance to the level
– Third HART value (TV)	Measurement certainty, level
– Fourth HART value (QV)	Electronics temperature
Indication value - DIsplay and adjustment module[2]	
– Displayed value 1	Filling height Level
– Displayed value 2	Electronics temperature
Resolution, digital	< 1 mm (0.039 in)

Output variable - Additional current output

For details on the operating voltage see chapter "Voltage supply"	
Output signal	4 … 20 mA (passive)
Range of the output signal	3.8 … 20.5 mA (default setting)
Signal resolution	0.3 µA
Failure signal current output (adjustable)	Last valid measured value, ≥ 21 mA, ≤ 3.6 mA
Max. output current	21.5 mA
Starting current	≤ 10 mA for 20 ms after switching on, ≤ 3.6 mA
Load	Load resistor, see chapter "Voltage supply"
Damping (63 % of the input variable), adjustable	0 … 999 s
Indication value - DIsplay and adjustment module[3]	
– Displayed value 1	Filling height Level
– Displayed value 2	Electronics temperature
Resolution, digital	< 1 mm (0.039 in)

Accuracy (according to DIN EN 60770-1)

Process reference conditions according to DIN EN 61298-1	
– Temperature	+18 … +30 °C (+64 … +86 °F)
– Relative humidity	45 … 75 %

[1] The output values can be assigned individually
[2] The indication values can be assigned individually
[3] The indication values can be assigned individually

– Air pressure	+860 … +1060 mbar/+86 … +106 kPa (+12.5 … +15.4 psig)
Installation reference conditions	
– Min. distance to installations	> 500 mm (19.69 in)
– Vessel	metallic, ø 1 m (3.281 ft), centric installation, process fitting flush with the vessel ceiling
– Medium	Water/Oil (dielectric constant ~2.0)[4]
– Installation	Probe end does not touch the vessel bottom
Sensor parameter adjustment	No gating out of false signals carried out
Typical deviation - Interface measurement	± 5 mm (0.197 in)
Typical deviation - Total level interface measurement	See following diagrams
Typical deviation - Level measurement[5][6]	See following diagrams

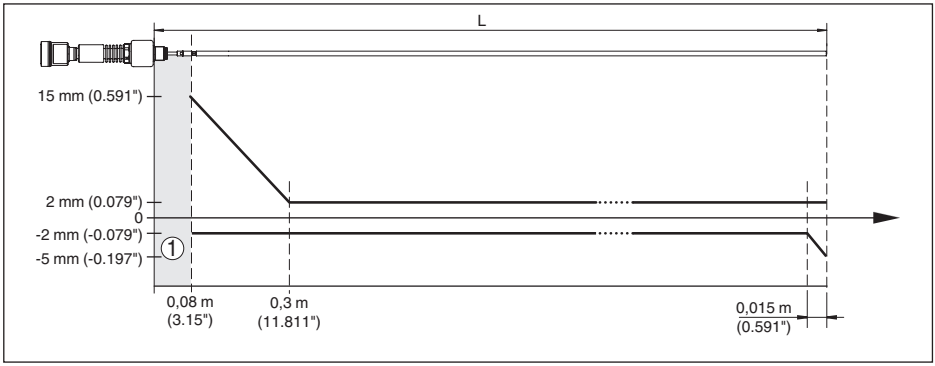


Fig. 47: Deviation VEGAFLEX 86 in rod version in water

1 Dead band - no measurement possible in this area
L Probe length

[4] With interface measurement = 2.0
[5] Depending on the installation conditions, there can be deviations which can be rectified with an adaptation of the adjustment or a change of the measured value offset in the DTM service mode
[6] The dead bands can be optimizes by a false signal suppression.

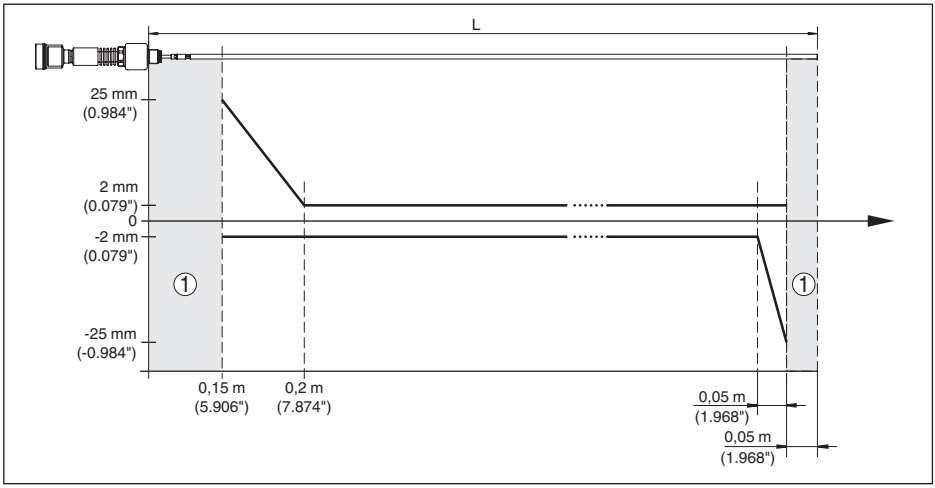


Fig. 48: Deviation VEGAFLEX 86 in rod version in oil

1 Dead band - no measurement possible in this area
L Probe length

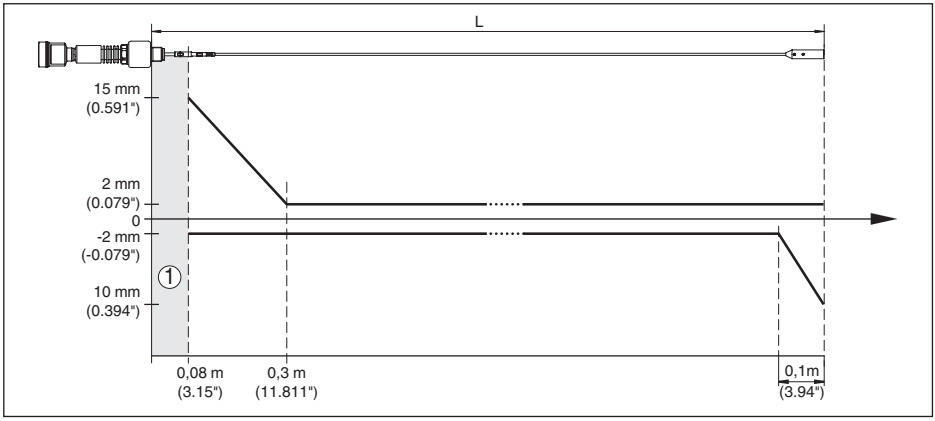


Fig. 49: Deviation VEGAFLEX 86 in cable version in water

1 Dead band - no measurement possible in this area
L Probe length

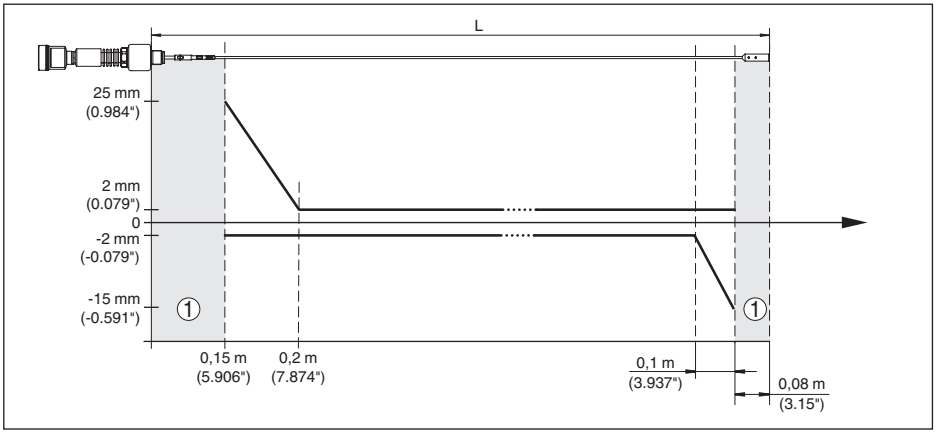


Fig. 50: Deviation VEGAFLEX 86 in cable version 2 mm (0.079 in), in oil

1 Dead band - no measurement possible in this area
L Probe length

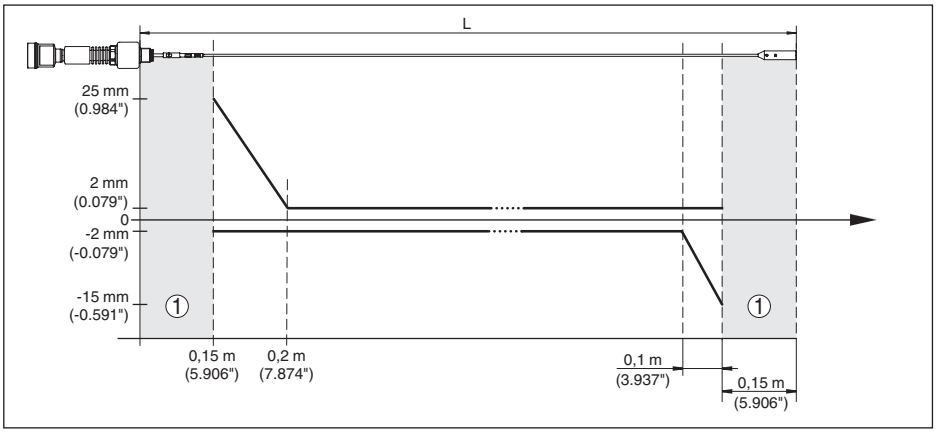


Fig. 51: Deviation VEGAFLEX 86 in cable version 4 mm (0.157 in), in oil

1 Dead band - no measurement possible in this area
L Probe length

Repeatability	≤ ±1 mm
Specifications of the safety tolerance (SIL)	Siehe Safety Manual

Variables influencing measurement accuracy

Specifications for the digital measured value

Temperature drift - Digital output	±3 mm/10 K relating to the max. measuring range or max. 10 mm (0.394 in)
Additional deviation through electromagnetic interference acc. to EN 61326	< ±10 mm (< ±0.394 in)

Specifications apply also to the current output[7]

Temperature drift - Current output	±0.03 %/10 K relating to the 16 mA span max. ±0.3 %
Deviation on the current output through analogue/digital conversion	< ±15 µA
Additional deviation through electromagnetic interference acc. to EN 61326	< ±150 µA

Influence of the superimposed gas and pressure to the accuracy

The propagation speed of the radar impulses in gas or vapour above the medium is reduced by high pressure. This effect depends on the superimposed gas or vapour and is especially large at low temperatures.

The following table shows the resulting deviation for some typical gases and vapours. The specified values refer to the distance. Positive values mean that the measured distance is too large, negative values that the measured distance is too small.

Gas phase	Temperature	Pressure				
		10 bar (145 psig)	50 bar (725 psig)	100 bar (1450 psig)	200 bar (2900 psig)	400 bar (5800 psig)
Air	20 °C/68 °F	0.22 %	1.2 %	2.4 %	4.9 %	9.5 %
	200 °C/392 °F	0.13 %	0.74 %	1.5 %	3.0 %	6.0 %
	400 °C/752 °F	0.08 %	0.52 %	1.1 %	2.1 %	4.2 %
Hydrogen	20 °C/68 °F	0.10 %	0.61 %	1.2 %	2.5 %	4.9 %
	200 °C/392 °F	0.05 %	0.37 %	0.76 %	1.6 %	3.1 %
	400 °C/752 °F	0.03 %	0.25 %	0.53 %	1.1 %	2.2 %
Steam (saturated steam)	100 °C/212 °F	-	-	-	-	-
	180 °C/356 °F	2.1 %	-	-	-	-
	264 °C/507 °F	1.44 %	9.2 %	-	-	-
	366 °C/691 °F	1.01 %	5.7 %	13.2 %	76.0 %	-

Characteristics and performance data

Measuring cycle time	< 500 ms
Step response time[8]	≤ 3 s
Max. filling/emptying speed	1 m/min

Ambient conditions

Ambient, storage and transport temperature	-40 … +80 °C (-40 … +176 °F)

Process conditions

For the process conditions, please also note the specifications on the type label. The lowest value always applies.

[7] Also for the additional current output (optional)

[8] Time span after a sudden measuring distance change by max. 0.5 m in liquid applications, max 2 m with bulk solids applications, until the output signal has taken for the first time 90 % of the final value (IEC 61298-2).

The measurement error through the process conditions in the specified pressure and temperature range is < 1 %.

Vessel pressure relating to the flange nominal stage	see supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*"
Process pressure	-1 … +400 bar/-100 … +40000 kPa (-14.5 … +5800 psig), depending on the process fitting
Process temperature	-196 … +280 °C (-321 … +536 °F)

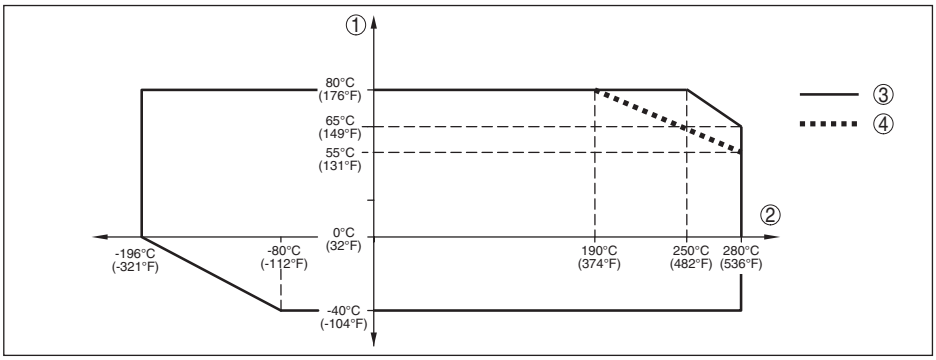


Fig. 52: Ambient temperature - process temperature (version -196 … +280 °C/-321 … +536 °F)

1 *Ambient temperature*
2 *Process temperature (depending on the seal material)*
3 *Maximum permissible temperature - standard*
4 *Limited temperature range - plastic housing and stainless steel housing, electropolished*

Process temperature	-196 … +450 °C (-321 … +842 °F) The measurement error from the process conditions is in the specified pressure and temperature range of below 1 %.

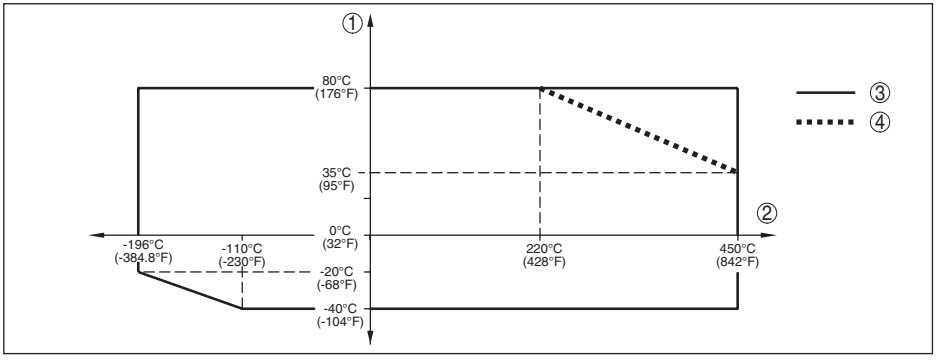


Fig. 53: Ambient temperature - process temperature (version -196 … +450 °C/-321 … +842 °F)

1 *Ambient temperature*
2 *Process temperature (depending on the seal material)*
3 *Maximum permissible temperature - standard*
4 *Limited temperature range - plastic housing and stainless steel housing, electropolished*

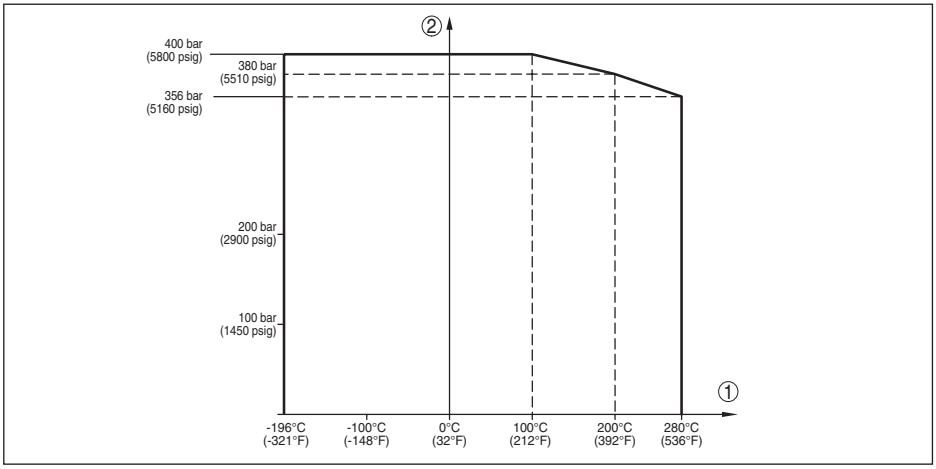


Fig. 54: Process pressure - process temperature (version -196 … +280 °C/-321 … +536 °F)

1 Process temperature (depending on the seal material)
2 Process pressure

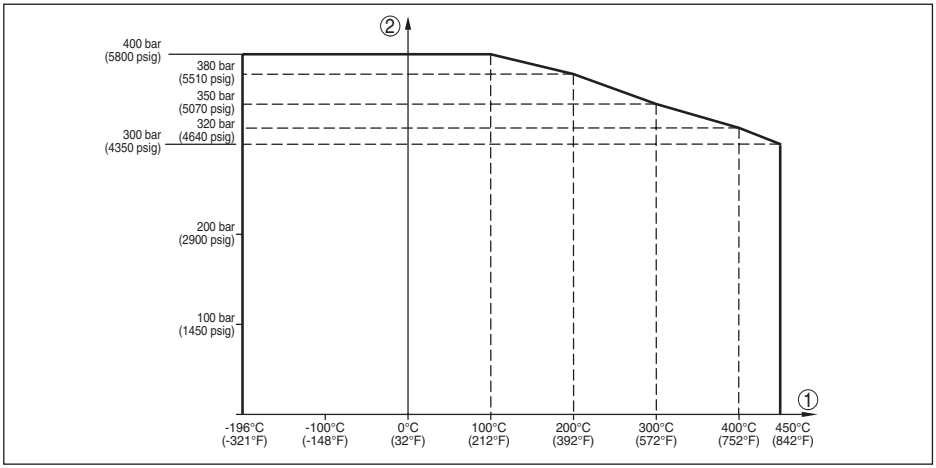


Fig. 55: Process pressure - process temperature (version -196 … +450 °C/-321 … +842 °F)

1 Process temperature (depending on the seal material)
2 Process pressure

Vibration resistance

– Instrument housing	4 g at 5 … 200 Hz according to EN 60068-2-6 (vibration with resonance)
– Rod probe	1 g with 5 … 200 Hz according EN 60068-2-6 (vibration at resonance) with rod length 50 cm (19.69 in)

Shock resistance	
– Instrument housing	100 g, 6 ms according to EN 60068-2-27 (mechanical shock)
– Rod probe	25 g, 6 ms according to EN 60068-2-27 (mechanical shock) with rod length 50 cm (19.69 in)

Electromechanical data - version IP 66/IP 67 and IP 66/IP 68; 0.2 bar

Cable gland	M20 x 1.5 or ½ NPT
Wire cross-section (spring-loaded terminals)	
– Massive wire, cord	0.2 … 2.5 mm² (AWG 24 … 14)
– Stranded wire with end sleeve	0.2 … 1.5 mm² (AWG 24 … 16)

Electromechanical data - version IP 66/IP 68 (1 bar)

Connection cable	
– Configuration	four wires, one suspension cable, braiding, metal foil, cover
– Wire cross-section	0.5 mm² (AWG 20)
– Wire resistance	< 0.036 Ω/m
– Tensile strength	< 1200 N (270 lbf)
– Standard length	5 m (16.4 ft)
– Max. length	180 m (590.6 ft)
– Min. bending radius	25 mm (0.984 in) with 25 °C (77 °F)
– Diameter approx.	8 mm (0.315 in)
– Colour - Non-Ex version	Black
– Colour - Ex-version	Blue

Display and adjustment module

Display element	Display with backlight
Measured value indication	
– Number of digits	5
– Size of digits	W x H = 7 x 13 mm
Adjustment elements	4 keys
Protection rating	
– unassembled	IP 20
– mounted into the housing without cover	IP 40
Materials	
– Housing	ABS
– Inspection window	Polyester foil

Integrated clock

Date format	Day.Month.Year
Time format	12 h/24 h

Time zone Ex factory	CET
Rate deviation max.	10.5 min/year

Measurement electronics temerature

Resolution	1 °C (1.8 °F)
Accuracy	±1 °C (1.8 °F)
Permissible temperature range	-40 … +85 °C (-40 … +185 °F)

Voltage supply

Operating voltage	
– Non-Ex instrument, Ex-d instrument	9.6 … 35 V DC
– Ex-ia instrument	9.6 … 30 V DC
– Ex-d-ia instrument	15 … 35 V DC
Operating voltage with illuminated display and adjustment module	
– Non-Ex instrument, Ex-d instrument	16 … 35 V DC
– Ex-ia instrument	16 … 30 V DC
– Ex-d-ia instrument	20 … 35 V DC
Interpolation protection	Integrated
Permissible residual ripple - Non-Ex, Ex-ia instrument	
– Frequency	16 … 400 Hz
– for 12 V< U_N < 18 V	≤ 0.7 V_{eff}
– for 18 V< U_N < 35 V	≤ 1.0 V_{eff}
Permissible residual ripple - Ex-d-ia instrument	
– Frequency	16 … 400 Hz
– for 18 V< U_N < 35 V	≤ 1.0 V_{eff}
Load resistor	
– Calculation	(U_B - U_{min})/0.0215 A
– Example - Non-Ex instrument with U_B = 24 V DC	(24 V - 9.6 V)/0.0215 A = 670 Ω

Electrical protective measures

Protection rating

Housing material	Version	IP-protection class	NEMA protection
Plastic	Single chamber	IP 66/IP 67	NEMA 4X
	Double chamber	IP 66/IP 67	NEMA 4X
Aluminium	Single chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	NEMA 6P NEMA 6P
	Double chamber	IP 66/IP 67 IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	NEMA 4X NEMA 6P NEMA 6P
Stainless steel, electro-polished	Single chamber	IP 66/IP 68 (0.2 bar)	NEMA 6P

Housing material	Version	IP-protection class	NEMA protection
Stainless steel, investment casting	Single chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	NEMA 6P NEMA 6P
	Double chamber	IP 66/IP 67 IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	NEMA 4X NEMA 6P NEMA 6P

Overvoltage category	III[9)]
Protection class	III[10)]

Approvals

Instruments with approvals can have different technical specifications depending on the version.

For that reason the associated approval documents of these instruments have to be carefully noted. They are part of the delivery or can be downloaded under www.vega.com, "*VEGA Tools*" and "*Instrument search*" as well as under www.vega.com/downloads and "*Approvals*".

12.2 Dimensions

The following dimensional drawings represent only an extract of all possible versions. Detailed dimensional drawings can be downloaded at www.vega.com/downloads under "*Drawings*".

Plastic housing

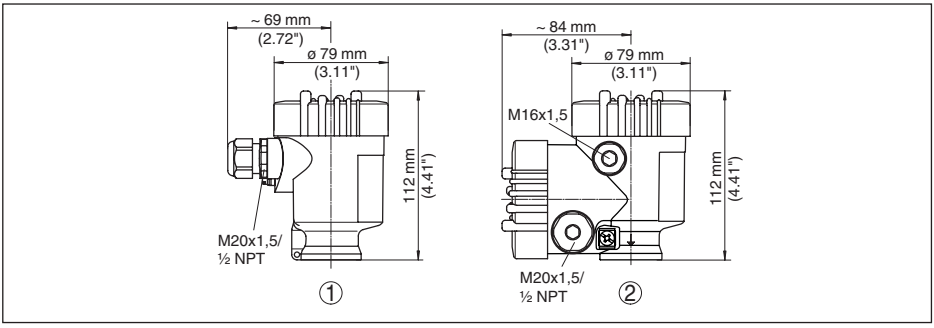


Fig. 56: Housing versions in protection IP 66/IP 68 (0.2 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Single chamber version
2 Double chamber version

9) IEC 61010-1
10) IEC 61010-1

Aluminium housing

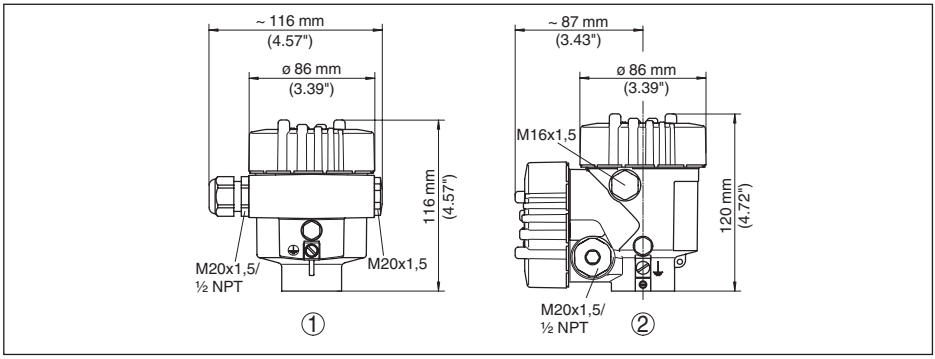


Fig. 57: Housing versions in protection IP 66/IP 68 (0.2 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Single chamber version
2 Double chamber version

Aluminium housing in protection rating IP 66/IP 68 (1 bar)

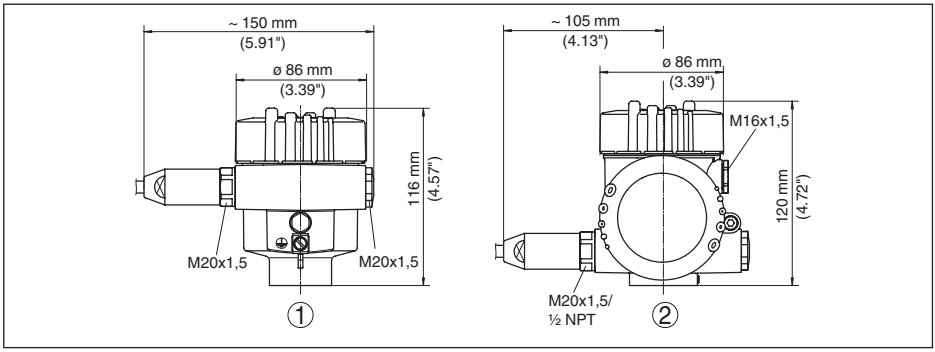


Fig. 58: Housing versions in protection IP 66/IP 68 (1 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Single chamber version
2 Double chamber version

Stainless steel housing

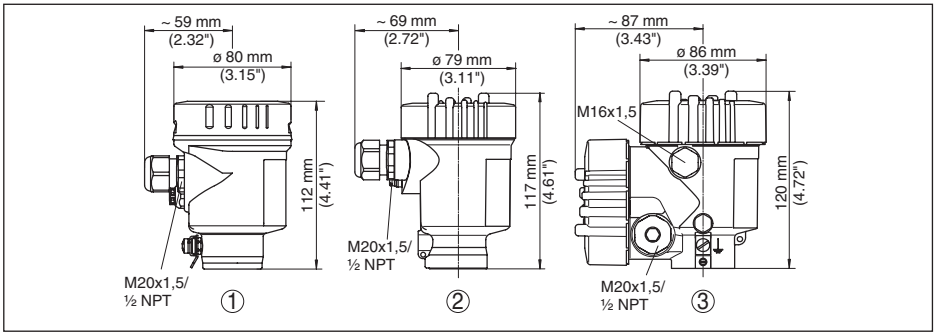


Fig. 59: Housing versions in protection IP 66/IP 68 (0.2 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 *Single chamber version, electropolished*
2 *Single chamber version, precision casting*
3 *Double chamber version, precision casting*

Stainless steel housing in protection rating IP 66/IP 68, 1 bar

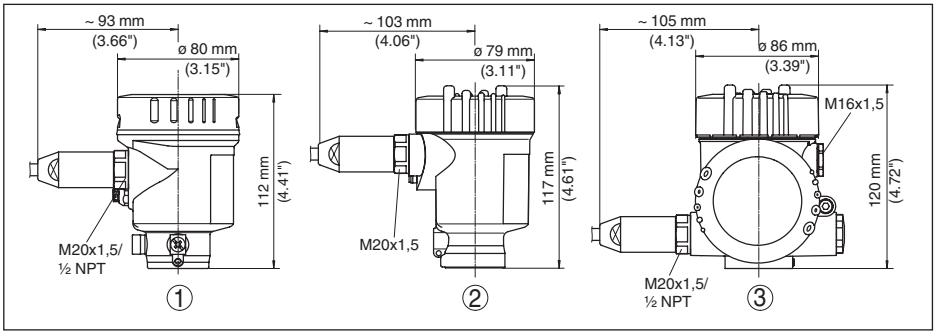


Fig. 60: Housing versions in protection IP 66/IP 68 (1 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 *Single chamber version, electropolished*
2 *Single chamber version, precision casting*
3 *Double chamber version, precision casting*

VEGAFLEX 86, cable version with gravity weight

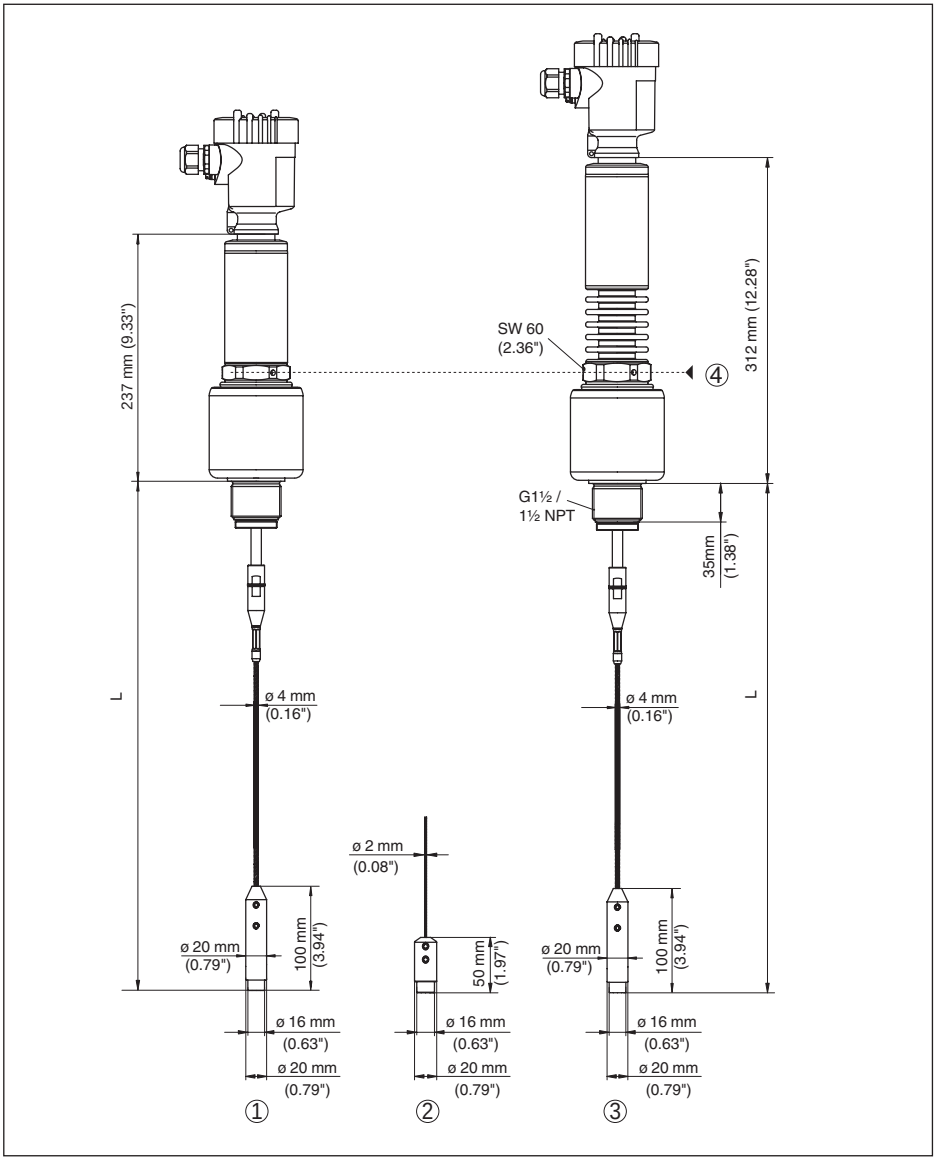


Fig. 61: VEGAFLEX 86, threaded version with gravity weight (all gravity weights with thread M8 for eye-bolt)

L Sensor length, see chapter "Technical data"
1 Cable ø 4 mm (0.157 in), temperature version -196 … +280 °C (-321 … 536 °F)
2 Cable ø 2 mm (0.079 in)
3 Cable ø 4 mm (0.157 in), temperature version -196 … +450 °C (-321 … 842 °F)
4 Max. height of the vessel isolation

VEGAFLEX 86, cable version with centering weight

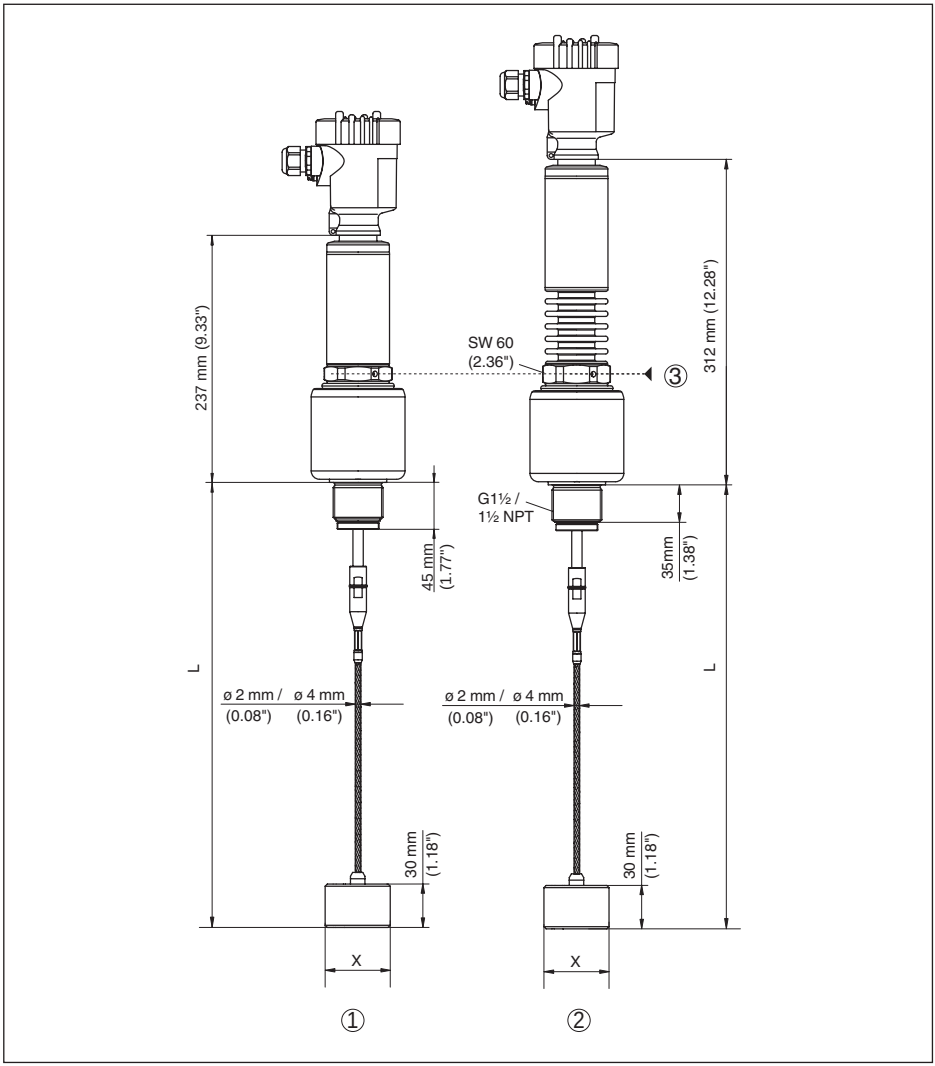


Fig. 62: VEGAFLEX 86, threaded version with centering weight

L Sensor length, see chapter "Technical data"

x ø 40 mm (1.57 in)
ø 45 mm (1.77 in)
ø 75 mm (2.95 in)
ø 95 mm (3.74 in)

1 Cable ø 2 mm (0.079 in)/cable ø 4 mm (0.157 in), temperature version -196 … +280 °C (-321 … 536 °F) - (see supplementary instructions "Centering")

2 Cable ø 2 mm (0.079 in)/cable ø 4 mm (0.157 in), temperature version -196 … +450 °C (-321 … 842 °F) - (see supplementary instructions "Centering")

3 Max. height of the vessel isolation

VEGAFLEX 86, rod version

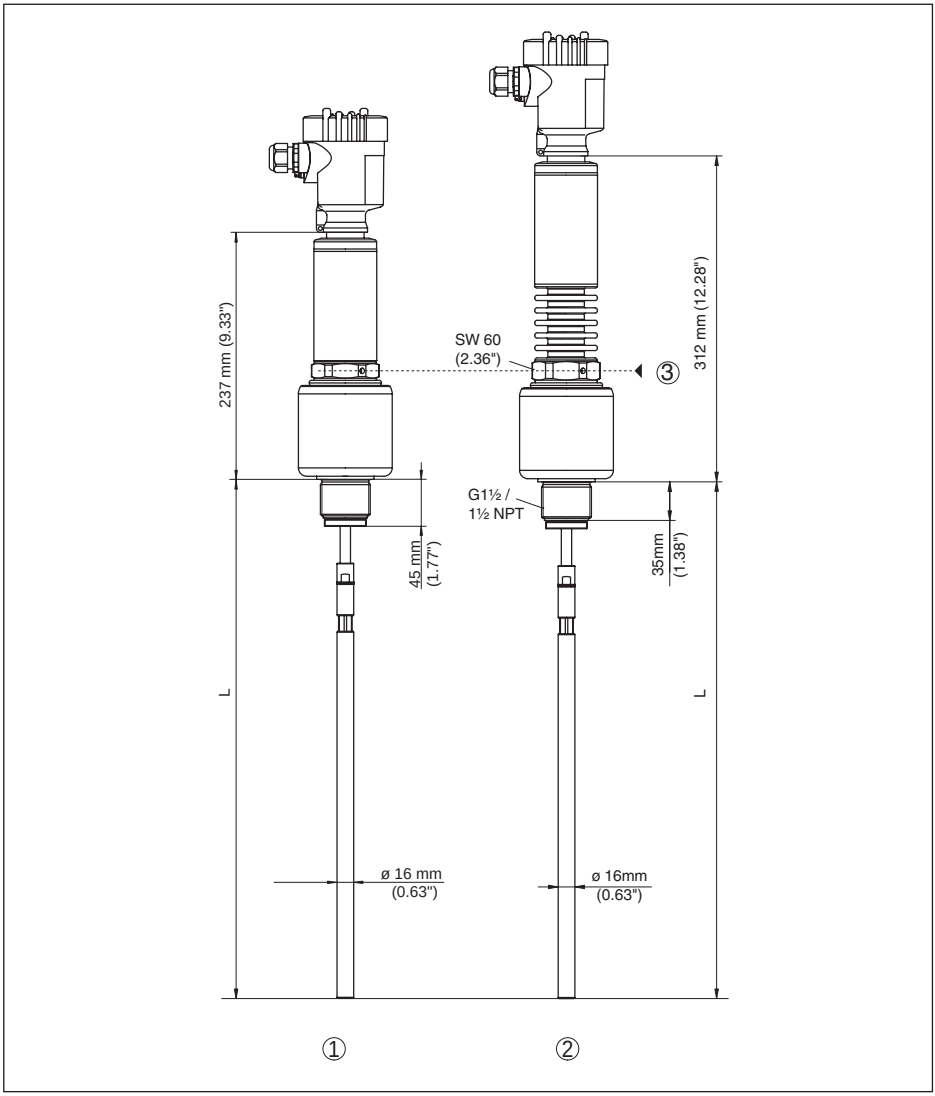


Fig. 63: VEGAFLEX 86, threaded version

L Sensor length, see chapter "Technical data"
1 Rod ø 16 mm (0.63 in), temperature version -196 … +280 °C (-321 … 536 °F)
2 Rod ø 16 mm (0.63 in), temperature version -196 … +450 °C (-321 … 842 °F)
3 Max. height of the vessel isolation

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INDEX

A
Adjustment
– Max. adjustment 43, 44
– Min. adjustment 43, 44
Adjustment system 39
Application 41, 42
Application area 8

B
Backlight 53
Block adjustment 40

C
Check output signal 71
Connecting
– Electrically 24
– Mechanically 14
– To the PC 62
Connection
– Steps 24
– Technology 24
Connection cable 23
Copy sensor settings 59
Current output 2 48
Current output Min./Max. 48
Current output mode 48
Current output, size 47
Curve indication
– Echo curve 54

D
Damping 44
Date of manufacture 60
Date/Time 56
Default values 56
Deviation 72

E
Echo curve memory 67
Echo curve of the setup 55
EDD (Enhanced Device Description) 65
Electronics and terminal compartment, single chamber housing 26
Electronics compartment, double chamber housing 26
Electronics compartment with Ex-d double chamber housing 28
Error codes 70
Event memory 66

F
Factory calibration date 60
False signal suppression 49
Fault rectification 71
Functional principle 8
Functional safety (SIL) 32
Function test 34, 51

G
Gas phase 42
Grounding 23

H
HART address 60
HART resistor 62
HART variables 48, 49

I
Inflowing medium 17
Installation position 15

K
Key function 38

L
Language 52
Linearization 45

M
Main menu 39
Meas. reliability 53
Measured value indication 52
Measured value memory 66
Measurement loop name 41

N
NAMUR NE 107 70
– Failure 68
– Function check 69

P
Peak value indicator 53, 54
PIN 33, 40, 50, 56
Probe length 41
Probe type 59
Proof test 55

R
Read out info 60
Release adjustment 50

44234-EN-140430

Repair 77
Replacement parts
– Bypass 13
– Display and adjustment module with heating 12
– Electronics module 12
– Rod extension 13
– Spacer 13
Reset 56

S

Scaling measured value 46, 47
Sensor characteristics 60
Sensor status 53
Service hotline 74
SIL 32
Simulation 54
Special parameters 60
Status messages - NAMUR NE 107 67

T

Type label 7
Type of medium 41

U

Units 41

V

Verify parameter 36
Vessel insulation 19

44234-EN-140430

Printing date:

All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the information available at the time of printing.
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44234-EN-140430

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